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A Journal of Practical Chemistry

IN ALL ITS APPLICATIONS TO

PHARMACY, ARTS, AND MANUFACTURES.

EDITED BY

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THE CHEMICAL NEWS

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THE ALKALI WORKS REGULATION ACT.

THE Alkali Works Regulation Act has now been in force twelve months. We say in force; but it is, we believe, a fact that the machinery for setting it in practical operation was not completed until some months after the Act legally took effect. There has been time enough, however, to draw some conclusions as to the practical results of the operation of the Act. Our readers will remember that the object of the Legislature was to compel manufacturers to condense at least 95 per cent. of the hydrochloric acid evolved in the production of soda from common salt. An opinion seems to be prevalent that the object was to prohibit the escape of noxious vapours from all chemical works; but, in fact, no such general enactment exists. The operation of the present Act is strictly confined to alkali works. Sulphurous fumes from copper works are allowed to escape as before; and the most careless management of chemical works still remains without Government interference. In a late action against a copper work in Lancashire, it was argued that the Act applied universally; but in the face of the precise words of the Act, it is needless to say the argument broke down. We have only, then, to see what has been the effect of the law, so far as regards alkali works. Now, it is a curious fact that in the course of our inquiries we have found that it is precisely in places, like St. Helens, most complained of (for an account of its condition see CHEMICAL NEWS, vol. vi., p. 202) that the Act has been most thoroughly effective. Indeed, we were informed that it has been so to an extent never dreamt of by the Legislature. It will be remembered that in their evidence before Lord Derby's Commission some of the principal members of the alkali trade insisted that perfect condensation was impossible; and that at least 5 per cent. of the acid must be allowed to escape. Lord Derby yielded to this representation, and 95 per cent. was the amount fixed upon to be condensed. Upon trial, however, it would seem that perfect condensation is by no means an impossibility. It is found, for example, that a cubic foot of the escaping gases from some manufactories may be passed through a solution of nitrate of silver without affording the least trace of a precipitate, whilst in one case the merest trace was found after the gas has passed through the solution without interruption for three days and nights. This carefulness, we are happy to learn, is spreading rapidly through the trade, and it is found that the manufacturers are not at all satisfied with keeping within the Act. They perceive, in fact, what was evident enough, that if 95 per cent. of the acid could be condensed, there could be no difficulty in condensing the whole, and they are doing their best to effect this, and so remove every possible cause of complaint. Nothing less was to be expected from gentlemen who gave evidence before Lord Derby's Commission, sometimes against themselves, with a fairness and straightforwardness which could not be too highly praised.

We have said that there is no difficulty in the way of complete condensation, nor is there when close furnaces are used. With open furnaces, however, it would seem that there must be some escape, but in the best of these the escape does not much exceed 1 per cent. At St. Helens we understand there are no open furnaces, so that this town has been so far favoured. And yet the wilderness around that town is not likely soon to blossom as the rose. It is still what it was described by a witness before the Commission, "one scene of desolation. You may look round for a mile, and not see a tree with any foliage on whatever." The fact is, that only one "noxious vapour" has been suppressed. Others no less deadly, but almost as easily prevented, are still allowed to escape as freely as before, and while these are at large the country round St. Helens can never be like what it was fifty years ago. We have made these last remarks chiefly to call attention to the fact that the Alkali Act has a very narrow territory, and no influence beyond it. But the satisfactory results of its operation will no doubt encourage the Legislature to proceed further in the same direction; and much as we deprecate, in a general way, Government interference with private enterprise, we are bound to express our belief that an extension of this enactment may be productive of much good.

DR. HOFMANN'S EXHIBITION REPORT.

A FEW weeks ago the newspapers reported the destruction of the last remaining portion of Captain Fowke's palace. Probably the last load of bricks and rubbish has now been carted away from the site, and the building is as much a matter of history as the Exhibition itself. The building may be forgotten as soon as possible, and much respecting the Exhibition it would be well to forget. But there is one thing we have no wish to forget—and if we had the wish our correspondents would not allow us to indulge it—and that is the Jury Report on Class II., Section A. Ever since we first announced the issue of this Report, and described the valuable nature of its contents, we have been continually receiving applications for information how to obtain it. The publication was, indeed, long delayed, but when the

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Report was perused the delay was forgiven. All the other Reports might easily have been written *currente calamo*, but even one of the greatest masters of chemical science could hardly collect and put together the information here detailed without much tedious labour.

The Exhibition Commissioners seem to have seen at once the value of the Report. All the others had been sold separately as they appeared, but this they seem to have reserved to secure the sale of the bulky and (but for this Report) almost worthless volume which contained the others.

It seems to have had the effect desired, for we have recently learned from Mr. Le Neve Foster that the Society of Arts (to which body the Reports were made over) "have no separate copies, and there are no bound copies for sale. It is out of print." The demand for Dr. Hofmann's report, however, still continues, and, considering the nature of the work, is likely to continue. Now, we do not know whether the Exhibition Commission is yet in existence, or whether it has wound up the affair and dissolved itself; but if it still exists we would once more urge the re-issue of this Report in a separate form. The publication would in all probability be profitable; but if it resulted in a loss, it would be a far better expenditure of the profits of the Exhibition than anything done with the money made in 1851. But supposing the Commission extinct, we feel confident that the scientific materials of the Report could easily be rearranged for a separate publication. At the present time there is no work on technical chemistry in the English language which contains so much useful information for manufacturing chemists, and a very small amount of labour would convert it into a book which would take a permanent place in our scientific literature.

We throw out the suggestion that an enterprising publisher would probably find it profitable to undertake this work, and we have reason to know that Dr. Hofmann would willingly lend his hand in making the requisite alterations and additions.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Chemical Examination of an Ancient Metal Statue of Buddha from Hindostan, by David Forbes, *F.R.S., &c.*

This statue was lately found by Messrs. Turnbull and Harris in the remains of a large temple discovered at Sooltangunge, on the Ganges, in excavating the ground for a station-yard on the Great East India Railway. The temple would appear to have been of remote antiquity, as on the mound of *débris* covering its extensive ruins the remains of another Buddhist temple are seen, built subsequently, and probably without any knowledge of the more ancient and far more extensive remains buried below it, and in which this statue was discovered.

The liberality of Mr. Samuel Thornton has rescued this interesting work of art from destruction, and by him it has lately been presented to the town of Birmingham.

The statue measures 7 feet 6 inches in height, and weighs about a ton. With the exception of the left foot, which is wanting, it is in a very perfect state of preservation. It is supposed to belong to the earliest period of the Buddhist faith, and consequently would probably be about 2500 years old.

It has been cast upon a core, which in the case of the arms has been strengthened by the introduction of a small bar of iron of about half an inch square. After casting, it appears to have been chiselled to the fine surface which it must have presented before the oxidation due to its long interment.

As the metallic alloy of which it is composed was one very unfavourable to anything like good casting, the numerous flaws which occur in it have been very cleverly concealed by pieces fitted in from outside.

When a fresh surface of the metal was disclosed by filing, it was found to present a dark copper colour, and the specific gravity was found to be 8·29 at 60° Fahr.

The analysis showed no traces whatever of tin, zinc, lead, antimony, or bismuth, and the percentage composition was found to be as follows:—

Copper	91·502
Iron	7·591
Silver	0·021
Gold	0·005
Nickel and manganese	traces
Arsenic	0·079
Sulphur	0·510
Insoluble slag	0·292
	100·000

From this analysis it would appear that the statue had been cast directly from crude or unrefined copper, and the absence of any intentional alloy would at first glance indicate a very early period of art. On the other hand, however, the iron stays used in the core of the statue and several iron work-tools (adzes, axes, &c.), found in an extremely oxidised condition along with the statue, would show that this latter metal, although so frequently hitherto regarded as evidence of a later civilisation, was one with which the founders of this statue were well acquainted.

Copper by itself giving but extremely imperfect and unsound castings, the use of alloy seems to have been one of the first advances made in practical metallurgy, and examinations of ancient metallic remains from the most distant parts of the world, whether amongst the Celts, Egyptians, South Americans, or others, shows that their experience has resulted in employing nearly the same proportions of copper and tin in the alloys that they made use of in the different countries.

The Dissociation of Carbonic Oxide,
by M. H. Sainte Claire Deville.

I have elsewhere described the curious phenomena of decomposition which take place with bodies submitted to the action of heat. Water and carbonic acid, which at the moment of their formation develope such great heat, possess the apparently paradoxical property of partially resolving themselves into their elements, when heated to a much lower point than that of their complete decomposition or the combination of the simple bodies of which they are constituted. I compared the phenomena of combination or complete decomposition with those of boiling or the condensation of vapours.

On certain compound bodies, such as water and carbonic acid, the gaseous elements of which have the property of recombining after having been separated at a high temperature, I employed a particular system of experimenting, which I have already described in various memoirs on this subject. For oxide of carbon, which is reduced to carbon and oxygen, that is to say decomposed into a solid and a gaseous matter, another kind of apparatus is required, its description being the object of this memoir.

The electric spark decomposes a great many bodies, and in all probability it acts upon them only by reason of the enormous heat it developes; it, therefore, seemed to me that if this decomposition was not always followed by a new combination of the separated elements, it might be caused by these elements being immediately placed in contact with an atmosphere in movement and relatively very cold. In fact, the mass or the number of molecules of greatly heated gas at the moment of the discharge is very small, on account of the smallness of the quantity of fire with respect to the surrounding gaseous mass, whose temperature scarcely varies; all these conditions are realised without electricity in the following manner:—Place in a furnace, the temperature of which can be raised to a very high point, a porcelain tube fitted with corks each pierced with two holes; into one of these holes at each end pass small glass tubes, one to carry gas into the porcelain tube, and the other to conduct it from the apparatus. The remaining holes admit a small brass tube eight mm. in diameter, which passes the whole length of the tube, and through which flows constantly a rapid current of cold water. Finally, two small screens of polished porcelain separate in the interior of the porcelain tube the part which should be heated and that which, on coming from the furnace, should be almost cold.

The apparatus being thus arranged, direct into the porcelain tube a current of pure, dry oxide of carbon, proceeding from apparatus giving out regularly from 4 to 6 litres an hour.* Pass the gas issuing from the porcelain tube into one of Liebig's potash bulbs or into baryta water, by means of which the presence and the quantity of carbonic acid are shown. The carbonic acid becomes apparent as soon as the porcelain tube is heated to redness. The oxide of carbon is then decomposed into oxygen, of which a part, if not the whole, has been employed to produce the carbonic acid, and into carbon, which attaches itself in the form of lamp black to the brass tube traversing the porcelain tube through and through. This brass tube, even at the warmest parts, is kept at about 10° by the continuous current of water. The mass of water is great enough to remain unheated while traversing the incandescent tube.

We have thus, in a very small space, a greatly heated cylindrical porcelain surface, and a very cold, concentrical brass surface. The molecules of oxide of carbon heated in the lower parts of the porcelain tube rise rapidly, after having been partially decomposed into oxygen and carbon, but, encountering the cold and rugged side of the brass tube, the particles of carbon mechanically attach themselves to it. From this moment, cooled as they are by the water circulating in the metal tube, they nevertheless escape the action of the oxygen or the carbonic acid which this oxygen may form at the expense of the excess of oxide of carbon. The brass tube is, in fact, found to be blackened by the carbon when the apparatus is carefully taken to pieces, and its quantity is in proportion to the quantity of carbonic acid fixed in the bulbs connected after the porcelain tube.

If I correctly understand this phenomenon, carbon should be found only on the lower parts of the brass tube, which alone receive the gaseous molecules at the moment when they are removed by heating from contact with the lower part of the porcelain tube. I have invariably found this to be the case in numerous experiments I have made with this kind of apparatus.

It will be seen that the method of experimenting I have just described is capable of great extension and numerous applications.

First, by making a very small slit in the brass tube at the spot where the gas coming in contact with it is hottest, and by making the water flow through a sufficiently long vertical tube, a kind of aspirator is obtained, by means of which the hottest gases can be exhausted, rapidly cooled by contact with water, and collected in an *eprouvette*, which will separate them from the flowing water. An apparatus of this kind, or modified according to circumstances, allows the gases to be drawn from a furnace, and the development and combustion of long flames to be studied.—*Comptes Rendus*, lix., 873. 64.

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* Oxide of carbon is prepared with dry oxalic acid and concentrated sulphuric acid. The gaseous mixture traverses several flasks containing solution of potash and several U-shaped tubes containing fragments of caustic potash. The oxide of carbon then passes into an iron tube filled with fine iron wires, and heated to redness. To free it from the carbonic acid produced under the influence of the iron, it is again passed through potash bulbs and over fragments of potash contained in a U-shaped tube. By operating in this way I am certain to exclude all traces of air or of carburetted gases. The flask containing the oxalic acid is heated by a gas apparatus giving a constant heat, regulated by means of a very delicate tap.

Notes on the Platinum Metals, by M. CAREY LEA.

PART II.*

(*Continued from Vol. x., page* 301.)

Reactions of Hyposulphite of Soda.—In the first part of this paper I described the reaction of sesquichloride of ruthenium with hyposulphite of soda, a substance which will probably be found to be the best touchstone which we have for detecting its presence. I shall now briefly describe the behaviour of that reagent toward other metals of the group, and then proceed to examine how its behaviour toward ruthenium is modified when one or more other metals are present in the same solution. The remarkable properties which the platinum metals possess of exhibiting in many cases reactions, when mixed, wholly different from those which they show separately, renders this a point of much importance.

The hyposulphite is to have a little ammonia added before using as already mentioned. The ammonia must be in sufficient quantity to ensure that the solution after the addition of the solution of the platinum metal shall be alkaline.

Bichloride of Ruthenium and Ammonium gives, with hyposulphite of soda mixed with ammonia and boiled, a rich sherry wine colour. This differs materially from the reaction of ammonia alone, which produces a pale straw colour; in both cases a very dilute solution is supposed to be used.

Sesquichloride of Ruthenium.—As already described, a rich red purple by boiling; when dilute, nearly a rose colour.

Bichloride of Iridium and Ammonium is simply decolorised.

Sesquichloride of Rhodium.—Straw colour or yellow, according to strength of solution.

Bichloride of Platinum.—The addition of hyposulphite of soda mixed with ammonia produces at first a precipitation of platinum sal ammoniac, which by heat (if the solution be not too strong) is re-dissolved to a yellow liquid. Boiling renders this at first paler, and almost colourless; the reaction then changes, and the colour deepens to a rich wine brown.

Protochloride of Palladium.—To apply the test to this metal, place a solution of hyposulphite in a test-tube with a little liquid ammonia, and add a drop of

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* *Am. Journ. Science and Arts*, No. 113, Vol. xxxviii.

palladium solution, so that it shall communicate a pale lemon colour only to the liquid. By boiling this rapidly darkens to a wine brown shade, increasing in intensity until it finally appears black. Dilution, however, shows that this results from its intensity only; the diluted liquid is clear from troubling, and has a warm brown tint.

Detection of Ruthenium in Presence of Iridium by Hyposulphite of Soda and other Reagents.—For the following examinations, solutions of sesquichloride of ruthenium and of chloriridiate of ammonium were used. Both in a state of perfect purity were weighed dry, dissolved, and mixed in the following proportions:—

Ru_2Cl_3, 1 part; chloriridiate of ammonium, 10 parts.

The hyposulphite test was not in any way impaired by the presence of iridium.

Sulphocyanide test gave a red colouration, but much less clear than in the absence of iridium,† and much inferior to the reaction with hyposulphite.

Acetate of lead added and boiled gave a precipitate in which the purplish shade characteristic of ruthenium was very evident.

Ru_2Cl_3 1 part; chloriridiate, 20 parts.

Hyposulphite gave a perfect reaction.

Sulphocyanide, reddish brown colouration and unsatisfactory.

Acetate of lead gives a precipitate still distinctly coloured by ruthenium. It is to be regretted that to judge correctly of this test it is necessary either to be very familiar with the colour of the precipitate which the lead salt produces with a ruthenium solution, or else to prepare it for comparison.

Ru_2Cl_3, 1 part; chloriridiate, 50 parts.

Hyposulphite gave a perfect reaction.

Sulphocyanide having failed in a solution containing a larger quantity of ruthenium, was not here again tried.

Acetate of lead gave a precipitate which, when carefully compared with that afforded by a perfectly pure iridium solution, exhibited a shade of difference, but scarcely sufficient to afford any criterion; at least, this must be regarded as the extreme limit of the sensibility of mixtures of Ru and Ir to this reagent.

Ru_2Cl_3, 1 part; chloriridiate, 100 parts.

Hyposulphite, perfect ruthenium reaction.

Ru_2Cl_3, 1 part; chloriridiate, 200.

Hyposulphite, satisfactory ruthenium reaction.

Ru_2Cl_3, 1 part; chloriridiate, 500.

Even in the presence of such an enormous excess of iridium salt, ruthenium is capable of being detected by a practised eye by means of the hyposulphite test, although the clear rose colour produced in the previous trials was here changed to an orange shade.

It may, therefore, be concluded that for the detection of ruthenium in the presence of iridium, the hyposulphite test is at least ten times more delicate than acetate of lead, and even much more so in comparison with sulphocyanide of potassium.

Dr. Gibbs has proposed a test for ruthenium by the use of alkaline nitrite and sulphide of ammonium. It was my wish to compare this method with that which I here describe, but I did not succeed in obtaining the reactions of which he speaks, although I tried both nitrite of potash prepared by passing the red fumes evolved by the reduction of nitric acid through a potash solution, and also with nitrite of soda prepared from the nitrate.

In the first part of this paper I recommended that when solutions containing very little ruthenium were to be tested, they should first be boiled with a little pure chlorhydric acid. This is an important point, the neglect of which may cause the presence of ruthenium to be overlooked when it exists in sufficiently large quantity to be recognisable, even by the ordinary tests, after this precaution has been taken.

After making the foregoing experiments, I had occasion, after an interval of some hours, to repeat them on the same diluted and mixed solutions which had been preserved in closed phials. I found no effect from hyposulphite. Selecting one containing sufficient ruthenium to render the sulphocyanide test available, I tried it, but equally without effect. The ruthenium had lost its power of reacting even in solutions which contained it in the proportion of $\frac{1}{26}$th of the iridium present.

It was immediately suspected that in consequence of the dilution it had become decomposed. A portion of the solution was then boiled with a little chlorhydric acid, when it at once recovered its sensibility to the various reagents.

It was long since pointed out by Claus that neutral solutions of sesquichloride of ruthenium were decomposed by boiling with separation of oxide of ruthenium, and that even without heat the separation took place by standing. But it appears that even acid solutions spontaneously decompose when very dilute if the excess of acid present is small.

I, therefore, recommend that in all cases where it is intended to test solutions for small quantities of Ru, that the solution be heated with a little dilute chlorhydric acid immediately previous. Of course, when the hyposulphite test is employed, the solution must be rendered alkaline with ammonia after boiling with the acid, and before adding the hyposulphite. Generally speaking it is advisable to use dilute solutions for testing for ruthenium; although it is then present in smaller quantity, it is immediately recognisable, because its reactions are then less marked by the iridium than when stronger solutions are employed.

The decomposition of dilute solutions of ruthenium, even when acid, may easily be observed without the aid of reagents. When such a solution of Ru_2Cl_3 is very largely diluted with water, it soon assumes a purple black colour, and after a few hours nearly the whole of the Ru falls to the bottom, leaving the liquid almost colourless. This I have found to take place in solutions containing Ru_2Cl_3, 1; water, 5000.

When the solution is somewhat less largely diluted, it gradually assumes a purplish red colour by standing, and then behaves for the most part differently with reagents than ordinary solutions of Ru_2Cl_3.

Detection of Ruthenium in Presence of Platinum by Hyposulphite of Soda.—Small quantities of Pt scarcely affect the ruthenium reaction. When larger quantities are present, the colour produced is a mixture of that which would result from each separately, and therefore rather a wine than a rose colour.

Mixtures of Ir and Pt, or of Ru, Ir, and Pt.—In all these mixtures, the reaction of the hyposulphite is that which would result from a mixture of the separate colourations.

The hyposulphite is a valuable test for the purity of iridium, and affords an easy indication as to whether other metals of the platinum group are present. Let

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† Claus remarks that this test fails when the Ru is in proportion to the Ir less than 1 to 10. As here the proportion is 1 of Ru_2Cl_3 to 10 of iridium sal ammoniac, the proportion of Ru is even less than 1 to 10 of Ir. The hyposulphite test is not in the least affected by even a much larger proportion of Ir.

the chloriridiate of ammonium be boiled with HCl, and then ammonia be added until the solution assumes the pale olive colour produced by alkalies in solutions of bichloride of iridium. The solution should be sufficiently dilute that, after the ammonia has been added it becomes nearly colourless. Now add the hyposulphite and boil. If any increase of colour whatever takes place, it is a certain indication of impurity. If the liquid becomes rose colour, ruthenium is present; if wine colour, platinum is probably present; if brown, palladium is probably indicated.

(To be continued.)

A New Method of Estimating Astringent Vegetable Matters, by M. Commaille.

According to Millon organic substances behave in three different ways when heated in solution with iodic acid. Some are burned by iodic acid when hydrocyanic is present; others are not attacked in the presence of hydrocyanic acid; lastly, there are some that are not oxidised by iodic acid under any circumstances. Vegetable astringent matters belong to the second group. The following method of estimating is founded upon the foregoing observations:—

Take a given volume of astringent liquid, add a few drops of hydrocyanic acid, then a given volume of a standard solution of iodic acid, of this there should be an excess, 0 gr. 5 being usually sufficient. Boil for a quarter of an hour. All the iodine set at liberty disappears. Decolorise the liquid, previously cooled and measured, by shaking it with well-washed animal charcoal; then estimate the remaining iodic acid.

It is now only needful to know how much iodic acid corresponds to a unit of tannin and gallic acid, to arrive at the weight of this body in the substance analysed.

It has been determined by means of iodide and iodate of silver that 1 gramme of gallic acid destroys on an average 2 gr. 366 of iodic acid, and that 1 gramme of tannin destroys 2 gr. 320 of iodic acid.

M. Commaille concludes by giving a table containing the quantities of astringent matters existing in a certain number of natural products.—*Bulletin de la Société Chimique.*

TECHNICAL CHEMISTRY.

On Cotton Seed and Cotton-seed Oil,
by A. Adriani, *M.D., &c.*

In addition to the short notice I gave on cotton seed (see p. 263, vol. x.), I now call attention to a few more particulars. It is to a certain extent a waste, or at least by product; the chief reason why the plant which produces the seed is cultivated is of course the cotton. Until within a few years the seeds, although it was known that they yielded an oil on being pressed, were left to decay and yield manure to the plants they were taken from. It will become a question of agricultural importance whether it is a sound and profitable proceeding to apply the seed as is done now to yield oil, and after expression of it, a cake to feed cattle. To the farmer the cotton seed will be of importance as food for cattle, after having been crushed. I understand its price is considerably lower than linseed, and it (the cotton seed) is, in nitrogenised and in fat-forming substances, in value not much below linseed. A bushel of cotton seed weighs about from 45 to 46 pounds, and the relative proportion of shell or husks and kernel in 100 parts I found to be for Egyptian seed as 37·45 husks to 62·55 kernels.

Cotton seed, after having been first crushed, then finely ground, and then heated to about 170° or 190° Fahr., yields on being pressed on the large scale a quantity of oil varying from about 15 to 18 per cent. This oil exhibits the following properties:—It is dark brown red coloured, not quite clear nor limpid, containing in suspension, and perhaps to a certain extent in solution, a larger or smaller quantity of mucilaginous and albuminous matter; the fluidity of the oil is from twenty-eight to thirty times less than that of water; its density slightly also varies, for one sample, being an average of twenty-four casks, I found the density or specific gravity at 54° Fahr. (12°·2 Cels.) 0·93074. Another sample, also fairly representing a large quantity of the oil, had at 58° Fahr. (14·4 Cels.) a specific gravity of 0·93169. The specific gravity of a portion of this sample, after having been submitted to a current of steam at 212°, and a thorough washing with boiling water, whereby, if not all, at least the greater portion of the vegetable impurities suspended in the oil were removed, and after filtering, was increased to 0·9343305 at 52° Fahr., care having of course been duly taken to have the sample which was taken for determining the specific gravity duly freed from any adhering water, by leaving a portion of the oil treated as first mentioned at 212° for several days.

This latter specific gravity is very near that of linseed oil, and the crude cotton-seed oil, in taste, odour, and other properties, save its colour, is very like linseed oil; it is akin to the latter, a drying oil, and may in many respects be applied as the latter. Crude cotton-seed oil is freely soluble in ether, sulphide of carbon, and benzole, but not sensibly in alcohol, neither, also, by application of heat; the alcohol, however, takes up from the oil a portion of the substance which imparts to the crude oil its peculiar colour. As regards the cause of the colour, I can positively state that from experiments I made, it is not, as might be perhaps presumed, due to the husks of the seeds. The husks of the carefully decorticated seeds do not yield anything sensibly soluble to either ether, alcohol, sulphide of carbon, or water; the cause of the colour has to be referred to the contents of small dark-coloured specks which even by the naked eye are seen dispersed over and through the yellowish-white mass of the kernels of the seeds; on examining a small section of the kernels under the microscope, the specks alluded to are observed to be cells filled with a rather dark pink coloured resino-fatty substance, soluble in alcohol, ether, and also—but undergoing an alteration at the same time—in weak solutions of caustic alkalies and ammonia: on crushing in a mortar a few of the decorticated seeds a dark reddish brown fluid is at once observed. The original colour in the seeds, as long as atmospheric air has not had time to act, is yellowish-green, and having placed a few of the carefully decorticated seeds in alcohol, in a closed flask, and having evaporated the alcohol over sulphuric acid under the receiver of an air-pump, after exhausting the air, I obtained the substance alluded to with its original colour. It is therefore pretty certain that the peculiar colour of the crude oil is due to the oxidation of a peculiar substance contained in the seeds; still it cannot *strictiori sensu* be called a dye, for, though I tried to fix the colour with proper precautions, and with such menstrua as could not injure the mordants, I did not succeed in getting either upon cotton or woollen fabrics properly mordansed any evidence of having to do with a dyeing material. The behaviour of the crude oil with reagents is certainly rather peculiar, but it should be borne in mind that the crude oil contains a large quantity of vegetable impurities, which no doubt play an important part in regard to the reagents wherewith the oil is brought in contact. I observed what follows:—

Concentrated sulphuric acid causes a beautiful purplish colour, which becomes stronger developed on stirring; after standing for twenty-four hours the mixture is much thickened and brownish red coloured.

Solution of bichromate of potassa in strong sulphuric acid being mixed with the oil causes an energetic reaction to take place, sulphurous acid is evolved, and the colour becomes deep blood red; after standing for nearly twenty-four hours the mixture exhibits a solid blackish mass.

On mixing the oil with strong nitric acid, the colour at first is dark olive green, but soon changes to light orange red; after twenty-four hours the oil was found solidified, and exhibited a dark orange red colour.

On mixing the oil with a solution of caustic potassa of a specific gravity of 1·22, the oil becomes thick and at first rather of a light yellowish colour, while the solution of kali becomes coloured. On stirring the mixture with a glass rod, those parts of the test-tube where air has more readily access to the mixture of oil and alkaline solution assume a tinge of blue purplish colour, somewhat akin to that which a solution of pyrogallic acid in potassa exhibits on exposure to air. After twenty-four hours the oil has become solidified. The bottom portion of the test-tube wherein the greater part of the solution of potassa had separated showed that solution deeply orange coloured. The blue purplish colour just alluded to was, if changed at all, a shade darker. With a solution of caustic soda the same phenomena were observed. On adding to the oil strong ammonia I observed a change of colour to yellowish green. Protonitrate of mercury in aqueous solution being mixed with the oil causes a change of colour to greenish yellow. After twenty-four hours the oil had become solidified and the colour dark olive green. Strong phosphoric acid, syrupyphosphoric acid, at first, on being added to the oil and shaken therewith, hardly effects any change, but after twenty-four hours I observed that the oil had become somewhat thicker and dark olive green coloured. On adding lime water, aqua calcis, to the oil it at once becomes solid and exhibits a dirty, brownish, yellow colour. The oil is not discoloured by sulphurous acid gas being passed through it; neither have some metallic combinations, as, for instance, chloride of zinc, chloride of tin, acetate of lead, any effect in withdrawing from the oil its peculiar colour, or if even at first some change appears to take place it is not permanent.

In its oxidised state, and no doubt also under the influence of vegetable substances met with in the oil, the colouring matter appears to have a predominating tendency to stick to fatty matter. The crude oil freezes at between 2° to 3° Cels., 26° to 28° Fahr. The oil is in its crude state excellently fit to yield soft and hard soap, and might advantageously replace linseed oil in dark coloured paints and varnishes, and perhaps in the manufacture of printing ink. The so-called refined oil, the best samples of which are fully equal in taste and colour to good olive oil, freezes between 28° and 32° Fahr., 2° to 0° Cels. I found its specific gravity at 61° Fahr. 16° Cels., to be 0·92647, its fluidity is about seventeeen times less than that of water. In the strictest sense what is called by the trade refined oil is a more or less pure oleic acid; this, at least, I found to be the case with the samples I had under examination. I abstain for the present from going into further details on this subject, and also refrain from making any observations on the constitution of this in many respects remarkable oil. I only wish to observe that, whereas hitherto the cotton crop is stated to be not exhausting to the soil, it becomes questionable whether the removal of the seed for commercial purposes instead of returning it to serve as manure to the plants it has been derived from, will not in shorter or longer time prove a bad policy.

In conclusion, I beg to tender my most sincere thanks to Professor W. A. Miller, who kindly gave me his permission to work on this subject in his laboratory at King's College. The refined oil is used for lubricating machinery, for burning in lamps, and the better kinds are no doubt mixed with other more expensive oils; being a perfectly sweet oil when well treated, I think it might answer well in many cases for pharmaceutical use.

PHARMACY, TOXICOLOGY, &c.

Action of Bichloride of Mercury on Hydrocyanic Acid, by MM. Bussy *and* Buignet.

On mixing bichloride of mercury in impalpable powder, with anhydrous hydrocyanic acid, no apparent action is produced. The salt remains in a solid state unaltered; no change takes place in the temperature, and the hydrocyanic acid boils at exactly the same point as when it is alone. There is, then, at least apparently, no action between these two substances.

But if, instead of using the acid in an anhydrous state it is diluted with a certain quantity of water, some curious and interesting phenomena are produced at the moment of mixing. For instance, by taking 3 grammes of anhydrous hydrocyanic acid, 12 grammes of water, and 15 of bichloride of mercury, the salt dissolves completely and instantaneously, like sugar in water. At the same time the temperature rises more than 15°, a circumstance which is more remarkable by contrasting with the change in the state of a salt which should produce cold by dissolving; then the liquid, which in the absence of the bichloride would boil at 40°, boils after the mixture only at 55°.

Hence it follows that in presence of water hydrocyanic acid and bichloride of mercury exercise an energetic reciprocal action, shown by the immediate dissolution of the salts by the elevation of the temperature at the moment of mixing, and by the higher boiling point of the liquid.

But what is the nature of this action? Is it, as might be supposed, a real chemical action, in consequence of which the elements of the two bodies are dissociated wholly or in part and recombined in different order? Is there, in fact, formation in greater or less quantity of cyanide of mercury, or of some quite different mercurial compound? The following experiments have been made with a view to solving this question:—

1. After having introduced into a small glass capsule 13 gr. 55 (1 equivalent) of bichloride of mercury, 2 gr. 70 (1 equivalent) of anhydrous hydrocyanic acid, and 10 gr. 80 (12 equivalents) of water, we placed the limpid solution resulting from this mixture, and which had given the above-described phenomena, under the receiver of an air-pump, above a second capsule containing quicklime. The experiment was made in the month of February at a temperature never exceeding +8°; at the

end of three weeks, the residue being perfectly dry, we examined it carefully, and found it to be formed simply of bichloride of mercury unmixed with cyanide or any other substance. Its weight, in fact, was 13 gr. 45.[*]

It was completely soluble in ether.[†] Its aqueous solution gave with caustic potash the same yellow precipitate as that given by this alkali with the pure corrosive sublimate. Finally, introduced into a small test tube with an equal weight of hydrochloric acid, and heated slightly, it disengaged no hydrocyanic acid. The distilled product, collected in slightly alkaline water, gave no prussian blue by the successive action of ferroso-ferric sulphate and hydrochloric acid, while by adding merely a trace of mercury to the mixture in the tube, the characteristic reaction was immediately obtained.

2. The same mixture of hydrocyanic acid, bichloride of mercury, and water having been carefully introduced into a small retort and carefully distilled till dry, we found in the product of the distillation the 98 centièmes of hydrocyanic acid which had been introduced in the mixture.

These two experiments appear to us to prove in the clearest manner that the affinity between bichloride of mercury and hydrocyanic acid is a pure affinity of solution, occasioning no definite chemical combination. For if it be supposed that one is formed at the moment of mixing, it must also be supposed to be so unstable as to be destroyed merely by concentration in a vacuum at a temperature not exceeding 8°. However that may be, this is an important action of bichloride of mercury, and it renders an exact account for all that takes place in the preparation of anhydrous hydrocyanic acid by Gay-Lussac's process. It shows how a very considerable portion of this acid may be retained in a liquid from which it would normally be disengaged; how bichloride of mercury may be dissolved in a very much smaller quantity of water than is ordinarily required; how, in short, ammoniacal salt added to the preparation destroys this special affinity by the formation of *sel alembroth*, and thus renders it possible to obtain the whole of the hydrocyanic acid indicated by theory.

Action of Protochloride of Mercury.—The affinity of hydrocyanic acid for bichloride of mercury is sufficiently powerful to effect by simple contact, and without the aid of heat, the transformation of protochloride of mercury into corrosive sublimate. This may be easily proved by pouring on protochloride of mercury an aqueous solution of hydrocyanic acid. The salt, originally white, immediately becomes grey, owing to the precipitation of a portion of the mercury in a metallic state, and a proportionate quantity of bichloride of mercury is formed.[‡]

The transformation of protochloride of mercury is remarkable for being connected with no cyanic compound of this metal,—contrary to what has hitherto been admitted. It is a simple dividing of protochloride into bichloride and metallic mercury owing to the affinity of hydrocyanic acid for the corrosive sublimate, as is the case when the same protochloride is treated by hot hydrochloric acid, or by certain alkaline chlorides, which transform it equally and simply into bichloride and metallic mercury.

By taking, as we did, one gramme of protochloride of mercury, and treating it at several intervals by an aqueous solution containing $\frac{1}{10}$th of hydrocyanic acid until the latter no longer removes any trace of soluble matter, a black, insoluble residue, composed of metallic mercury, will remain; dried in the same tube in which the operation was performed, it weighed 0 gr. 42. On the other hand, hydrocyanic solutions, evaporated to dryness by gentle heat, leave a residue weighing 0 gr. 56—a number which, like the preceding, agrees with the theoretical division corresponding to the formula—$Hg_2Cl = Hg + HgCl$.

Moreover, this saline residue gives all the characteristics of the pure corrosive sublimate. It is perfectly soluble in ether; its aqueous solution gives a yellow precipitate with caustic potash; it disengages no hydrocyanic acid when heated with hydrochloric acid in a test tube. It is then impossible to admit that any other combination is formed.

A very singular result of our observations, but one which might have been foreseen from the above, is that while the aqueous solution of hydrocyanic acid exercises an instantaneous and manifest action on protochloride of mercury; the anhydrous acid has, on the contrary, no sort of action on this salt.

By placing together, in a test-tube, 0 gr. 1 of protochloride of mercury and two or three cubic centimetres of pure hydrocyanic acid, nothing appreciable takes place, though the mixture is shaken so as to establish perfect contact between the two substances. This state of things is maintained during several weeks without any change taking place, especially if the mixture be kept from bright light. But on the addition of a few drops of water the reaction is produced immediately; the protochloride takes a grey tint, and some corrosive sublimate is found in the solution.

It is not only in the action of hydrocyanic acid on the two chlorides of mercury that the intervention of water is necessary. At every turn in the study of this acid are found new examples of the singular influence of water in determining reactions in which, from the nature of its elements, it would not appear to participate.

Thus, in presence of water, hydrocyanic acid is coloured immediately by the action of chloride of calcium; in the anhydrous state, on the contrary, it may remain in contact with the salt during several weeks without showing any sign of alteration.

In the same way aqueous hydrocyanic acid placed in the vacuum of a barometer will, after a time, be found to exercise a certain action on the mercury of the apparatus, while we have preserved anhydrous hydrocyanic acid for more than three months in the vacuum of a barometer, without its losing its transparency, and without any appreciable diminution in the elastic force of its vapour.—*Annales de Chemie et de Physique*, iii., 247. 64.

Testimonial to Dr. Odling.—Dr. Odling's old pupils at Guy's Hospital have lately shown their appreciation of their late teacher by presenting him with a handsome claret jug and fish knife and fork.

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[*] This figure does not represent the whole of the weight of sublimate experimented upon. The difference is to be ascribed to the projection of a small quantity of matter, in consequence of the rapid boiling of the liquid at the time the vacuum is formed.

[†] This solubility in ether would not suffice to prove the absence of cyanide of mercury, for this salt, in presence of the corrosive sublimate, forms the combination of chlorocyanide, HgCyHgCl described by M. Poggiale (*Comptes-Rendus de l'Academie des Sciences*, xxiii. 765), and we found that the whole of this combination dissolves in 20 parts of ether.

[‡] This experiment recals a well-known pharmaceutical fact that protochloride of mercury added to an emulsion of bitter almonds produces a blackish colour in consequence of the separation of metallic mercury, a phenomonon which does not occur when sweet almonds are substituted for bitter. Several explanations more or less satisfactory have been given of this fact, the therapeutic consequences of which M. Mialhe has given in a memoir in the *Journal de Pharmacie*, iii. 218 (1844).

PROCEEDINGS OF SOCIETIES.

ACADEMY OF SCIENCES.

December 26.

M. H. St. Claire Deville presented a memoir "*On the Constitution of Sal Ammoniac and Vapour Densities.*" The author has shown that when ammoniacal gas and hydrochloric acid are brought in contact at 360° C., they disengage heat, and therefore combine at a temperature at which the density of the vapour of sal ammoniac gives that body an equivalent of eight volumes. The accuracy of this experiment has been called in question by Wanklyn and Robinson, so the author has repeated the experiment under more determined conditions, which he now describes. These conditions leave no doubt that the gases when brought in contact have been raised to the temperature of 360° C., and the elevation of temperature of this mixture is no less incontestable. The fact, then, and its consequences must be accepted. M. Deville subsequently offers the following difficulties for solution by the advocates of anomalous vapour densities. Sulphydric acid forms with ammonia two distinct, crystallised, and volatile compounds:—NH_4S, sulphide of ammonium, or sulphydrate of ammonia; NH_4S,HS, sulphydrate of sulphide of ammonium, or bisulphydrate of ammonia. Sulphide of ammonium represents four volumes of vapour, and its condensation is equal to one-third; sulphydric acid and ammonia therefore combine, and remain in combination at the temperature (100° C., for example,) at which we take the vapour density. Sulphydrate of sulphide of ammonium represents eight volumes of vapour, and its condensation is 0. If we suppose its elements to be separated at the temperature at which the vapour density is taken (100°), we are obliged to suppose that it divides into ammonia and 2HS, giving each four volumes, equal to eight volumes. But, in fact, at this temperature, it can only split into sulphide of ammonium and sulphydric acid, one representing four and the other two volumes—total, six volumes. If sulphydrate of sulphide of ammonium was decomposed into its own vapours, it should thus furnish six volumes; but experiment shows that it gives eight, hence it is not to be decomposed, and its vapour has nothing anomalous. The author goes on to argue that, in the cases of carbonic, sulphurous, and acetic acids, sulphur, &c., which give vapour densities varying with the temperature, it is really their co-efficients of dilatation which go on diminishing as the temperature increases, until they take the minimum value 0·00366, that which agrees with hydrogen. Supported on this variability of density is the hope that if a sufficiently high temperature could be reached the densities of phosphorus and arsenic would be diminished by half; this hope the experiments of the author and M. Troost do not allow him to share.

M. Kuhlmann gave a continuation of a memoir which he has entitled *Researches on the Crystallogenic Force.* Our readers will remember that the author made the discovery that a solution of sulphate of magnesia or sulphate of zinc, thickened with gum and distributed over a glass plate, covered that glass plate with crystallisations. In the present communication he describes the methods he has adopted for etching these crystallisations on the glass. For this purpose he mixes fluoride of copper or zinc with the solution of sulphate of magnesia, and afterwards exposes the plate to the action of sulphuretted hydrogen, or dips it into strong sulphuric acid. Fluorine is thus set free, and, acting on the glass, produces a picture of the crystals. The author states that even better engravings are produced by exposing the plate to gaseous fluoric acid. Mr. Bingham suggested to him the silvering of the back of the engraved plate, which no doubt has an exceedingly pretty effect. M. Kuhlmann has gone a step further, and endeavoured, with some success, to fix his designs by vitrification. With this view he mixed easily vitrifiable substances (chromate of lead, for example) with his saline solutions, and, after heating in a muffle, found the crystalline design in relief coloured greenish by the oxide of chromium. He tried other colouring agents—oxides of copper, cobalt, and manganese—with more or less success. It is most important that these substances should be in the finest possible state of division. Porcelain and earthenware can be treated in the same way. M. Kuhlmann believes that he has founded a new industry; he has certainly done enough to set other experimentalists on the same pursuit.

A report "*On the Sucrates of Lime*" was read. Peligot has described two of these—a monobasic ($C_{12}H_{11}O_{11},CaO$), obtained in the cold by the direct action of syrup on slaked lime; and a tribasic compound ($C_{12}H_{11}O_{11}3CaO$), precipitated when the solution of the former is boiled. MM. Boivin and Loiseau contested the accuracy of this, and appealed to the Academy for a commission to test the truth of their views and experiments. The commission now reported at some length, with the evident object of making things agreeable to both parties, and gave the opponents of M. Peligot the credit of having discovered a bibasic sucrate of lime.

M. Maumené presented a note "*On the Density of Carbon in its Combinations.*" The author appears to be in search of artificial diamonds, and sees that the first step must be to find a carbon compound in which the carbon has the same density as the diamond. He finds this to be the case in oil of turpentine; but that would seem to be a hopeless body to experiment upon. More likely are the iodides of carbon, in which also the author believes the carbon to have the density 3·53. These bodies, he says, must be very easy to decompose, since they have never yet been isolated, because of their instability. Serulla's process for the preparation of one iodide, he tells us, does not answer; but Hoffmann quotes an experiment which seems to involve the formation of a real iodide of carbon. It is the decomposition of iodoform in a sealed tube heated to 150° C. In this experiment it is said that biniodide of methylene $C_2H_2I_2$ is produced; and according to M. Maumené the decomposition must be as follows:—

$$2C_2HI_3 = C_2H_2I_2 + C_2I_4.$$

Hoffmann speaks only of the first derivative; but the second has greater importance, for it may serve for the preparation of the diamond. It is not known, however; and we may heartily wish the author success in his search for it.

NOTICES OF BOOKS.

On the Chemistry of the Feeding of Animals for the Production of Meat and Manure. By J. B. Lawes, F.R.S., F.C.S. (Paper read before the Royal Dublin Society.) 1864.

How to make beef and mutton is a question which often arises in a man's mind, especially at this season of the year. To agriculturists, however, the question has a more permanent and practical interest; and they will read this paper, we have no doubt, with close attention. Whether they will be much enlightened by it depends upon several circumstances; but the most favourably circumstanced reader will most likely agree with the remark made by the author at the end of the paper—viz., that the subject of the chemistry of feeding is essentially an intricate one, and that much remains still to be determined by careful investigation. For what Mr. Lawes has done he deserves our best thanks: we hope he will continue his valuable experiments, and some day bring the practical results of them within the comprehension of the ordinary agricultural intellect.

We have no space to go at length into the question of the chemistry of feeding; but we must make room for an extract or two:—

"The actual amounts of food," says Mr. Lawes, "assumed to be required for the production of 100lbs. of live weight are—for oxen, 250lbs. of oil-cake, 600lbs. of clover-hay chaff, and 3,500lbs. of swedes; for sheep, 250lbs. of oil-cake, 300lbs. of clover-hay chaff, and 4,000lbs. of swedes; and for pigs, 500lbs. of barley-meal." Thus we see in the case of oxen 4,350lbs. of food, containing 1,109lbs. of dry substance, consumed to produce 100lbs. of live weight; and these 100lbs. of increase actually represent only 9lbs. of lean and 58lbs. of fat, the bulk of the remainder 31·4lbs. being water.

Considering the difference in the size of the animal, it would seem strange, at first sight, that a sheep should consume 4,550lbs. of food to gain 100lbs. increase of weight—that is, 200lbs. more than an ox to gain the same increase. But the food in this case contains only 912lbs. of dry material, which still only furnishes 7½lbs. of lean to 63lbs. of fat. A pig, on 500lbs. of barley-meal, or 420lbs. of dry material, produces 7lbs. of lean to 66lbs. of fat.

Our readers will see from this how small a portion of food is stored up in the body, and how much is necessary to keep the living machine in action.

In human adults, the whole of whose food is in most cases used up in keeping the machine going, this does not look so extraordinary; but we must confess to some astonishment at seeing that an animal at the age selected for fattening should require so much.

Some natural questions suggest themselves also as to the possibility of varying the proportions of fat and lean produced. Here we see that the highest proportion in the case of beef is 9 per cent. Now what should be the proportion in a normal healthy animal? Taking all the soft parts, is 9 per cent. of nitrogenous matter to 58 per cent. of non-nitrogenised the most that Nature will furnish?

We can hardly suppose that Mr. Lawes has not directed his attention to this question. After every Smithfield show it is regularly asked whether animals are fed for food, or for the tallowchandler and soap boiler? If it be found impossible to have more than 9 per cent. nitrogenous matter laid up, it must be submitted to; but we think the matter deserves further investigation.

We have stated nothing about the relation of the food to the manure produced. All over-nourished animals, mankind included, necessarily make rich manure, and a wise economist will no doubt consider this in feeding his stock. But it should be remembered that an excess of nitrogen in food always tends to the production of diseased conditions of body, manifestations of which may possibly be found in the flesh of an overfed ox. We believe, indeed, that it is impossible to regard an ordinary prize fat ox, sheep, or pig as a healthy animal, and are disposed to question the goodness of their flesh as food.

This, however, is a physiologist's question, and we must quit the subject now, only expressing a hope that Mr. Lawes will continue his experiments, and soon, dropping for the time the scientific jargon about nitrogenised and non-nitrogenised matters, tell the farmer in plain English the best way to feed his cattle.

Annales de Chimie et de Physique. November, 1864.

This journal contains several papers with which our readers have already been made familiar; the completion of MM. Buignet and Bussy's paper on Hydrocyanic Acid, the researches on Copper by MM. Millon and Commaille, M. Lamy on Thallic Alcohols, and M. Maumené's general theory of Affinity, for example. Besides these, there are two papers on physics, one by M. Magnus, on the condensation of vapours on the surface of solid bodies, the other by M. des Cloizeaux, on the optical properties of castor and petalite. The only other article is by MM. Christophle and Beilstein, "*On the Colouration of the Flame of Hydrogen by Phosphorus and its Compounds, and the Spectrum of Phosphorus.*" Phosphorus communicates a green colour to the hydrogen flame, and gives in the spectrum two magnificent green lines, and a third fainter between the two former and near to that of sodium. The two lines α and β have about the same intensity; the line γ is fainter, and the line α is the strongest. The lines P β and Ba δ correspond perfectly, and the lines P α and Ba γ are only separated by two divisions. Many experiments gave the authors identical results. They suggest the spectrum experiment in toxicological investigation. They further state that the blue colour of the flame of hydrogen obtained by means of iron is due to phosphorus.

Annalen der Chemie und Pharmacie. November, 1864.

The first paper in this journal is by E. Reichenbach and F. Beilstein, "*Researches on Isomerism in the Benzoic Series.*" In it the author describes *dracylic acid*, which appears to be identical with benzoic acid. It is obtained by treating a boiling alcoholic solution of amidodracylic acid with nitrous acid. In a notice of Hofmann's *test for tyrosine* Meyer confirms its accuracy. The test is a solution of mercuric nitrate, which boiled with a solution of tyrosin gives a flocculent red precipitate, and leaves a nearly colourless liquor. A short notice of "*The Basic Compounds of Aldehydes with Ammonia,*" by Petersen, gives a meagre account of the compounds of benzoic, cinnamic, and anisic and valeric aldehydes. A. Schoyen describes "*A New Isomer of Tartaric Acid,*" which he names *glycotartaric acid*. When glyoxal, the aldehyde of oxalic acid, is mixed with strong hydrocyanic acid, a compound is formed which boiled with caustic potash evolves ammonia. When this evolution ceases the liquor is neutralised with acetic acid, and precipitated with acetate of lead. The lead precipitate decomposed by sulphuretted hydrogen gives a solution of the acid in question. Of a paper by R. Otto, "*On the Action of Chlorine on Cyanide of Ethyl,*" we can only give the title. A communication by R. Fittig, "*On some Derivatives of Diphenyl,*" contains an account of the bromine and sulphur compounds. Several short papers by Weltzien follow, which are of no particular interest. In one of these, however, "*On the Action of Ammonia or Ignited Carbon, and the Formation of Cyanogen,*" the author states in opposition to Kuhlmann, that no hydrocarbon is produced in the action, but only cyanide of ammonium, hydrogen, and nitrogen. A candid communication by Bahr admits "*The Probable Identity of Wasium with Thorium,*" and so far contradicts Nickles, who has stated that wasium was impure yttria; and also Delafontaine, who asserted that it was a mixture of cerium and didymium.

We may return to this paper at some other time. All the other papers in this number of the Annalen have appeared or been noticed in the Chemical News.

Watts's Dictionary of Chemistry, &c. Part XXIII.
Longman and Co.

The present part carries us from Magnesium to Menthol, and includes two excellent articles, one on Magnetism and the other on Manures.

NOTICES OF PATENTS.

1058. *Treating Titanic Iron Sands.* B. F. Brunel, Brussels. Dated April 27, 1864. (Not proceeded with.)

The inventor proposes to apply the native iron-sands of New Zealand and Italy to several new purposes. As a grinding material and substitute for emery powder, the mineral is to be employed either in its natural condition or after pulverisation between iron rollers, which by a stream of hot water are kept at a temperature ranging between 140° and 175° Fahrenheit. The iron sand may also be used as a pigment, or as the chief ingredient of a metallic cement or luting for uniting the joints of metal and other pipes. For these last-named purposes the mineral is reduced to the state of an impalpable powder in the mill, and afterwards dried by a current of hot air. The specification describes also the means of polarising the particles of magnetic oxide of iron by the employment of electric coils, &c., which the inventor deems a great advantage when about to be applied as a paint to surfaces of iron or steel.

1081. *Treating Wood and other Ligneous Substances in order to Produce Alcohol, and to obtain the Cellular Tissue or Fibre from such Substances, applicable to the Manufacture of Paper and other Uses.* R. A. Brooman, Fleet Street, London. A communication. Dated April 29, 1864.

The sawdust, wood raspings, &c., are to be boiled with dilute hydrochloric acid of a strength varying from 5 to 12 per cent. of real acid, and for a time regulated according to the state of division and other circumstances from six to fifteen hours. The glucose thus formed may afterwards be converted into alcohol by the ordinary fermentation process, and the residual cellular fibres or tissue employed in the manufacture of millboards and paper.

1092. *Manufacture of Syrups.* F. Leisz, New Coventry Street, Leicester Square, London. A communication. Dated April 30, 1864. (Not proceeded with.)

In a manner very similar to the preceding the inventor treats potato-starch with dilute sulphuric acid, according to the well-known process, for its conversion into glucose, and afterwards neutralises the excess of acid with chalk. The saccharine solution is then poured off from the sediment of sulphate of lime, and concentrated to a syrup in the vacuum apparatus.

1088. *Improvements in the Purification of Gas, and in Obtaining a Valuable Product in the process, and for the Preparation of Some of the Materials to be Used in the said Purification.* F. C. Hills, Deptford. Dated April 29, 1864.

The inventor supplements his former process for the preparation of a gas-purifying material by adding to the sulphate of iron formerly employed either sulphate of magnesia or precipitated sulphate of lime, by which means the absorption both of ammonia and sulphuretted hydrogen from the foul gas is rendered more certain.

1113. *Lubricating Compounds.* P. Ward, Bristol. Dated May 3, 1864.

For lubricating steam-engine cylinders, the patentee uses the lime-compound of a fatty acid, or any other earthy soap, dissolved in petroleum oil. To this mixture may be added, if desired, a certain proportion of tallow, crude grease, or of any good lubricating oil.

1119. *Treating Animal Charcoal.* E. Beanes, Argyll Street, London. Dated May 4, 1864. (Not proceeded with.)

For the purpose of renovating animal charcoal (bone-black) which has been repeatedly employed in decolourising sugar and other solutions, it is proposed to treat it with nitrous acid, sal-ammoniac, nitrate of ammonia, or even carbonic acid, for the purpose of dissolving out the phosphate of lime, and other mineral salts, when, after thorough washing with water (and drying), the animal charcoal becomes again serviceable for renewed application.

It is well known, however, that, after the removal of the lime salts by washing with acid, the animal charcoal is not nearly so efficacious an agent for the removal of colouring matters as in its original form of bone-black.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

Grants of Provisional Protection for Six Months.

2943. R. A. Brooman, Fleet Street, "An improved lighting composition and an improved apparatus for lighting, together with the employment of pyrophorous materials for the lighting of cigars, pipes, and other articles."—A communication from Charles de Chaugy, Brussels.—Petition recorded Nov. 24, 1864.

3010.—E. Bevan, Birkenhead, and A. Fleming, Liverpool, "An improvement in the construction of bottles, jars, and like vessels of capacity, and improved means for securing or fastening corks and other stoppers therein."—Dec. 3, 1864.

3030.—T. Atkins, Fleet Street, "Combining apparatus used for regulating, adjusting, and indicating the supply and flow of hydrocarbon and other gases and vapours, with improved apparatus for effecting the perfect carburation and purification of such gases and vapours for illuminating and other purposes, and for improvements in the construction of the apparatus for effecting the same."—Dec. 6, 1864.

3062. R. A. Brooman, Fleet Street, "Improvements in apparatus for cooling and freezing."—A communication from Marcar Beylih'g, Constantinople, Turkey.—Dec. 8, 1864.

Notices to Proceed.

2029. S. Moore, Liverpool Street, "Improvements in electro-gilding."—Aug. 15, 1864.

2039. C. F. Darcagne, Upper Thames Street, "A new mode of treating or preparing the sorgho plant (*holchus sorghum*) so as to render the fibre thereof useful in manufactures as a substitute for horsehair and otherwise."—Aug. 16, 1864.

2072. F. Taylor, Romsey, "Improvements in apparatus for receiving, drying, and deodorising human excrement."—Aug. 22, 1864.

2095. R. Beard, jun., Clapham, and W. Downing, Battersea, "Improvements in the manufacture of artificial leather, and in colouring, dyeing, or finishing the same, which latter improvements are also applicable to the colouring or dyeing of the ordinary leather cloth."—Aug. 24, 1864.

2100. R. A. Brooman, Fleet Street, "Improved apparatus for lighting and for firing charges in mines and other blasting operations."—A communication from A. Dumas, Privas, France.—Aug. 25, 1864.

2104. R. Hill, Birmingham, "Improvements in the manufacture of iron and steel."—Aug. 26, 1864.

2181. W. H. Perrin, Sudbury, "Improvements in preparing colouring matters for dyeing and printing."—Sept. 6, 1864.

2794. J. McCall, Houndsditch, and B. G. Sloper, Walthamstow, "Improvements in preserving fresh meat, poultry, game, and fish, and in vessels employed therein."—Nov. 10, 1864.

2854. J. Rowley, Camberwell, "Improvements in the manufacture of printer's ink."—Nov. 15, 1864.

CORRESPONDENCE.

Continental Science.

Paris, January 3.

Let me notice first the re-opening of the laboratory in which MM. Fremy and Chevreul allow young men who have ideas to work out to make their researches *gratis*. Pure chemistry is not often a profitable study pecuniarily, and apparatus is sometimes expensive; but in this establishment all devoted young chemists find a hearty welcome and every encouragement, together with whatever may be necessary for carrying on their experiments. This is only the second season, and we have hardly had time to see whether the opportunities offered have been successfully seized upon; but the generous founders deserve to see good results from their generosity.

Another gratuitous institution deserves a passing notice —the evening lectures at the Sorbonne. These lectures most resemble the lectures given to the *élite* of the London scientific world at the Royal Institution, but are open to all who apply for tickets in time. The scientific lectures are illustrated in Royal Institution style, and the experiments are always attractive. In his lectures on the conversion of liquids into vapour last week, M. Boutau used very ingeniously the electric light and thermo-electric pile to make changes of temperature visible to a large audience. He also showed Mr. Groves's experiments on ebullition. Lastly, he spoke of and illustrated the spheroidal condition of liquids, and promised to repeat Boutigny's experiment by putting his hand into melted lead; but he only melted the lead, and did not put his hand into it, so the audience went away dissatisfied.

M. Ronquayrol, an engineer, has invented a new apparatus for supplying divers with air. It consists of a reservoir of compressed air, on the top of which is a chamber closed by an india-rubber cap. By a simple arrangement, just sufficient air for one inspiration is let into this chamber, and passes thence to the mouth of the diver. The chamber thus forms a sort of artificial lung.

A method of purifying water was patented here some time ago by M. Scheurer, of Freiberg, which has not, I think, been noticed in England. The author makes use of neutral persulphate of iron. The quantity of this agent employed depends, of course, upon the amount of impurity present, which is easily determined from time to time as may be required. Soon after the sulphate is added it decomposes and deposits an insoluble basic salt, the particles of which carry down with them the suspended impurities. The invention seems to have but a limited application, since the dissolved impurities are left unaffected.

Dr. Hofmann, in his valuable Exhibition Report, pointed out how great a blessing cheap caustic baryta would be to manufacturing chemists. A M. Szerlecki has devised a process which will not, perhaps, realise all the conditions, but which, nevertheless, deserves attention. He commences, of course, with converting the sulphate of barium into sulphide, and this latter he boils with oxide of copper, and thus procures sulphide of copper and caustic baryta. The sulphide of copper he either converts into sulphate or roasts to recover the oxide. The process is very simple, and seems quite practicable. If so, here is the change which will "revolutionise the alkali manufacture."

I may here mention another industrial operation which has just come into action, and which somewhat resembles a process described in the Exhibition Report. It is a process for recovering the cotton from mixed fabrics of wool and cotton. Mr. F. O. Ward, you will remember, submits rags of these fabrics to the action of superheated steam under pressure, and so converts the wool into an impalpable powder "ulmate of ammonia," which serves as a manure, while the cotton freed from the dust is available for paper. M.M. Gelis and Dussart here appear to submit the rags to a regulated heat in retorts, and so obtain from the wool ammonia and a substance which is available in the manufacture of prussiate of potash, and among other secondary products, gas to light their works or heat part of their retorts, and after all this find the cotton remaining, and available for paper.

Another ingenious, but it would seem not original, discovery, is that of M. Cauderay, who describes an electro-chemical method of pointing pins and needles. It is known that if the two electrodes of copper, iron, or steel are set vertically in acidulated water, and reaching nearly to each other, the positive very quickly becomes pointed. The experiment can of course be made by making the positive pole of a number of wires, and carefully regulating the distance of the negative pole. Two or three Bunsen's cells only are required to do the work. Considering the diseases which come of pointing pins and needles in the usual way, this method certainly deserves some attention, although some supplementary polishing would seem inevitably required. M. Gaston Plante claims the first mention of the bare fact in 1860; but allows the ingenious application to the manufacture of pins and needles to M. Cauderay.

MISCELLANEOUS.

Lenoir's Gas-Engine.—M. Lenoir has succeeded in effecting a long-desired object—namely, the construction of a powerful engine, which dispenses with steam as the motive force. In appearance the Lenoir engine is very much like a horizontal steam-engine, having a cylinder, piston, crank shaft, and fly wheel; the cylinder has the necessary slide arrangements for the admission of coal-gas and atmospheric air in due proportions, which, at the proper moment, is ignited by the electric spark—contact being made and broken by the rotary action of the crank shaft—the expansive force, consequent on the ignition, gives motion to the piston on each side alternately. The cylinder has a water jacket surrounding it, through which a stream of hot or cold water is kept gradually flowing, to absorb any excess of heat. The mixture exploded is about eleven volumes of air to one of gas. The consumption of gas is as near as may be seventy feet per horse power per hour of actual work, giving a cost, with gas at 4s. 6d. per 1000 feet, of about 4d. Besides this extraordinary cheapness, the engine is recommended by its simplicity, cleanliness, and safety. When set in motion the machine requires no attention, and the batteries only require to be charged once a week. The engine may be seen at work daily at 40, Cranbourn Street.

Royal Horticultural Gardens.—Dr. Septimus Piesse has, during the past week, lectured at the above gardens on "Perfumes, Flower-gardening, and the Methods of Obtaining the Odours of Plants." The lecturer gave an excellent account of the process of *enfleurage* as it is followed in the Valley of the Var, and also the methods of cultivation adopted in the flower gardens there. The object of the lecture, it seems, was to instruct young gardeners who are emigrating to warm British colonies, so that they might lay the foundation of the same industry in some of our possessions.

Royal Polytechnic Institution.—Seldom have instruction and amusement been so happily combined as in the varied entertainments provided at this old and deservedly popular Institution. The Christmas programme includes several novelties, which will be witnessed with pleasure both by young and old. The Ghost Lecture has undergone a further modification in the hands of Mr. Pepper, and is about to enter upon the third year of its existence. The present representation is descriptive of the Hindoo custom of sacrificing the widow upon the funeral pile of her departed husband, and is ingeniously shown by a series of tableaux portraying the fanciful incidents of an Indian maiden's dream—her courtship, marriage, the departure of her soldier-husband, his mortal wound in combat, and the final immolation of the living with the dead on the funeral pile. The scenery in itself is well arranged and very effective, and the ghostly combat of five soldiers altogether unprecedented as a spectral representation. A fairy tale, by the Brothers Grimm, entitled "Snow-white and Rosy-red," is likewise well told and illustrated by five spectral tableaux; and a very clever optical extravaganza recounting the truly wonderful adventures of Baron Munchausen is humourously described by Mr. R. Coote. The Shadow Scene has been so often exhibited at the Crystal Palace and the Polytechnic by Mr. Pepper that it cannot assert a claim to novelty; but in connection with the old pantomimic representation a novel effect has been introduced, which, invented by Mr. Cheshire, shows a curious phenomenon, in the shape of a combination of moving limbs, arms and legs, without any visible body and head. A revival of the old Physioscope carries back the memory to an early period, when an elderly gentleman, of gigantic proportions and benignant countenance, used to take a glass of wine with us at the Polytechnic, and satisfy his hunger by swallowing in a mouthful a liveried attendant. A series of photographic reproductions from statuary at the late International Exhibition, the work of the London Stereoscopic Company, is exhibited on the large screen by the oxyhydrogen light. Some of these are very effective, particularly "The Finding of Moses" and "Defending the Pass;" but others, and especially the celebrated figures by Monti, show in the high lights a granulation which mars the general effect. These obvious defects are no doubt partly attributable to the dark-grey patches and veins in the marble, which have already given the sculptor so much anxiety; but they do not appear to be wholly attributable to this cause. The Magic Tub will have a charm for the juveniles on Thursdays, whilst Mr. Stokes is aiding the "Memory" of the elder section of the company, and Signor Blitz will amuse all alike with his wonderful troop of dancing dinner plates.

Popular Science.—We copy, for the amusement of our readers, the following extracts from an article on the late explosion at Manchester, which appeared in a journal making, as our readers will see, some pretension to science: "The use of oxygen gas was never more prevalent than at present. In the exhibition of the patent ghost of Messrs. Pepper and Dircks it is an indispensable adjunct, and it has become a substitute, in almost all cases, for the coloured fires so long used for the production of supernatural 'effects' at our theatres. Again, the oxyhydrogen light, which depends for its extreme brilliancy upon oxygen, is extensively employed in the illustration of scientific lectures and for the purposes of popular amusement. The coloured lights, it need not be said, *are produced by the transmission of the rays of oxygen in combustion through heated lime* and stained glass, and were first used by Professor Ansell, at the Panopticon, some years since. By the introduction of these and similar scientific improvements, oxygen has become almost a necessity, *although its expansive and explosive properties* make it as dangerous to deal with as high-pressure steam or gunpowder—that is, in the hands of the tyro in chemistry. The accidents of Saturday night last arose principally from the palpable ignorance or want of observation of the unfortunate photographer. In the elimination of oxygen it is of the greatest importance that the closest attention should be paid to the evolvement of the gas, and, when ebullition ceases, that the heat which causes it should also cease to play upon the retort. These points poor Crowther appears to have neglected entirely; hence the super-heating and consequent expansion of the gas to the bursting strain. The oxygen most extensively used for the purposes named is eliminated from mixtures of chlorate of potassa and manganese, and all chemists are aware that the operation goes on with great rapidity. They accordingly provide apparatuses of sufficient strength to resist sudden pressure, and they are especially careful in apportioning the materials correctly. If too much manganese be employed rapid fusion ensues, and the fused mass, driven by the evolving gas, quickly chokes the conducting tube, shuts up the safety-valve as it were, and an explosion necessarily follows, as it would in a steam-boiler under parallel circumstances. The proper proportions in which chlorate of potassa and manganese should be mixed are, a quarter of a pound of the former to a quarter of an ounce of the latter. The manganese really undergoes scarcely any chemical change, but acts principally by catalysis. This combination, if heated slowly over a gas flame, which, from the power we have of regulating its volume, is by far the best medium for effecting elimination, evolves oxygen gas, at first slowly, but soon with much rapidity; finally, the masses ignites, or rather glows into a red heat, and the oxygen is then given off with violence. These facts assuredly lead to the conclusion that under no circumstances should an ordinary fire be used for the elimination, or manufacture, as it is sometimes absurdly termed, of oxygen gas, from chlorate of potassa and manganese. It is safer to use glass vessels than those of any other material, because, if an explosion unfortunately happens, in spite of all precautions, the damage done to life and limb will then inevitably be comparatively small. For eliminating oxygen on a small scale, a Florence oil-flask will answer as a retort exceedingly well, but, for extensive operations, an iron bottle, and the employment of black oxide of manganese *as a catalysis*, will be found advantageous and safe." To this we may append a paragraph extracted from the *Times* of Tuesday last:—

"**Uses of Petroleum.**—Hitherto this mineral oil has been almost exclusively spoken of as an illuminating substance, and as such it has at least as many adversaries as it has friends. But it possesses also other qualities, the value of which is less open to dispute. We mentioned a few days ago the property it possesses of destroying the parasites that prey upon the human body, and we will now add that it may become one of the most important auxiliaries in the art of dyeing, in which it is calculated to produce quite a revolution, it having just been discovered that it contains the principles of aniline, the well-known vegetable base derived from indigo, and which is now so commonly used for producing splendid rose-coloured stuffs. Aniline has hitherto been obtained by treating indigo with a concentrated solution of potash, whereby a brownish oily substance is formed, which by distillation yields pure aniline, a clear colourless liquid, having the smell of wine, but a corrosive and poisonous taste. The salts of aniline are also colourless, but rapidly assume a mellow rose colour by exposure to the air. White wood dipped into a solution of a salt of aniline takes a deep yellow colour. Hydrochloric acid turns these salts green, blue, or black, according to the concentrated state of the solutions. For the present, experiments are still in progress for extracting aniline from petroleum at a cheap cost, and there is every reason to suppose that these efforts will be crowned with success. Certain odoriferous ethers may also be extracted from petroleum, and there is even a talk of substituting petroleum for coal or coke for steam purposes."—Probably so many misstatements as are to be found in this paragraph have seldom been compressed into the same number of words.

ANSWERS TO CORRESPONDENTS.

Vol. X. of the Chemical News, containing a copious Index, is now ready, price 10s. 8d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. XI. commenced on January 6, 1865, and will be complete in 26 numbers.

C. R.—Yes, under favourable circumstances.

G. will see that his suggestion has been adopted.

R. K.—Yes, the colourless base, precipitated by carbonate of soda.

Books Received.—Chymical Magic, by S. Piesse, Ph.D.; Quarterly Journal of Microscopical Science; Hardwicke's Science Gossip; On Microscopical Research in Relation to Pharmacy, by H. Deane, F.L.S., and H. B. Brady, F.L.S.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Notes on the Platinum Metals, by M. Carey Lea.

Part II.*

(Continued from page 5.)

(IV.)

Reactions with Tetrathionic Acid.—Tetrathionic acid is capable of giving useful reactions with metals of the platinum group, and especially with palladium.

Ru_2Cl_3 boiled with tetrathionic acid is somewhat decolorised, and finally becomes muddy and greyish.

$RuCl_2$ boiled with tetrathionic acid, gradually darkens in colour, becomes muddy, and finally throws down a brown precipitate. But if the acid be at first supersaturated with ammonia, the solution becomes yellow and remains clear.

Ir_2Cl_3, when boiled with tetrathionic acid, the pale, almost colourless dilute solution darkens rapidly, and by some moments' boiling becomes a deep wine brown, remaining clear. If the acid be first supersaturated with ammonia, the reaction does not take place.

$IrCl_2$ is quickly decolorised by boiling with the acid. The decolorised solution does not darken by further boiling.

$PtCl$ is instantly precipitated in the cold by tetrathionic acid. The precipitate has a dark chocolate brown colour. This precipitation without heat is highly characteristic of the protochloride of palladium, and the test is of great delicacy. A single drop of a rather dilute palladium solution was added to two ounces of water. In a few drops of this very dilute solution, the presence of palladium was made evident by this test. When the quantity of palladium present is so very minute as in this case, no precipitation takes place, but a brown colouration is developed. And as this colouration is produced in the cold, it is highly characteristic of the metal in question.

$PtCl_2$.—Tetrathionic acid produces no effect in the cold. By boiling, a wine brown colour is developed, but no precipitation takes place.

As this test for palladium appeared likely to be a valuable one, a series of experiments was undertaken to ascertain whether, like so many of the old tests for metals of the platinum group, the reaction would be affected by the presence of other members of the group. Mixtures were therefore made of solution of protochloride of palladium with the following substances respectively:—Sesquichloride of ruthenium, bichloride of ruthenium, sesquichloride of iridium, bichloride of iridium, and bichloride of platinum.

In all these cases it was found that the reaction was obtained without difficulty, so that this test is capable of detecting palladium with ease in the presence of either of the above-named compounds. When but little palladium is present, the reaction commences with a darkening of the solution, and the precipitate falls only after an interval of one or two minutes or longer, according to the degree of dilution.

(V.)

Reactions with Sulphate of Quinia.—With sulphate of quinia, protochloride of palladium gives a bulky buff coloured precipitate, which becomes somewhat blackish on boiling. Neither ruthenium nor iridium give similar reactions.

(VI.)

Reactions with Protochloride of Tin.—Ru_2Cl_3, boiled with $SnCl$, becomes perfectly colourless, if the solution is very dilute. Stronger solutions show a pale straw colour.

$RuCl_2$, boiled with a small quantity of $SnCl$, gives a buff coloured precipitate, which dissolves in an excess of the precipitant, to a solution which, by further treating, passes to a splendid blood red of great intensity.

The buff coloured precipitate is soluble in solution of potash, producing an intense brown liquid.

Ir_2Cl_3.—When the sesquichloride of iridium and ammonium is boiled with $SnCl$, and potash added in sufficient quantity to re-dissolve the precipitate which it at first produces, further boiling produces an abundant leather coloured precipitate, which is insoluble in any excess of potash.

I felt much interested to observe whether this reaction would take place in the presence of sesquichloride of ruthenium in the solution, and had the satisfaction to find that it did so. We thus have a mode of detecting iridium in the presence of ruthenium which offers certain advantages.

The best way to observe the reaction is as follows:—To the solution of sesquichloride of ruthenium, add a little acidulated protochloride of tin, and boil till the colour disappears, and then add excess of potash. The liquid should be perfectly clear and very nearly colourless. The addition of a single drop of dilute solution of sesquichloride of iridium communicates a yellow colour, which rapidly deepens by boiling, and an abundant leather-coloured precipitate falls. The almost perfect decolorisation of the ruthenium solution by the protochloride of tin adds to the nicety of this reaction. Those only who have been annoyed by the extreme difficulty of getting any indication of the presence of small quantities of iridium in ruthenium solutions will appreciate the full value of this test.

(VII.)

Reactions with Ammonio-Chloride of Zinc.—A solution of chloride of zinc in excess of ammonia gives an interesting and beautiful series of reactions with the metals of the platinum group. The metallic solutions which are to be subjected to this test must be either neutral or slightly acid. The presence of alkali in excess, or of acid in large excess, naturally interferes with these reactions.

To obtain the zinc solution in proper condition, chloride of zinc must be added to ammonia until the smell of ammonia becomes tolerably faint, and a considerable proportion of zinc oxide remains undissolved. The liquid is then to be filtered off, and should be used without too much delay. In this condition the affinities are in a state of very unstable equilibrium. The addition of even a few drops of water produces a precipitate. It is precisely this instability which gives the solution its value for the purpose under consideration. When it is added to a solution of a platinum metal, the precipitate which falls carries with it a part or the whole of the platinum metal, which imparts to it a characteristic colouration.

The following are the reactions:—

Ru_2Cl_3—a brown precipitate: the solution becomes colourless.

$RuCl_2$—a rose-coloured precipitate: the solution becomes colourless.

Ir_2Cl_3—a pale buff precipitate: the solution becomes colourless, or nearly so.

$IrCl_2$—a fire-red precipitate: solution decolorised.

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* *Am. Journ. Science and Arts*, No. 113, Vol. xxxviii.

With platinum and palladium, the tendency of ammonia to form double salts interferes, and prevents any characteristic reaction from the zinc solution.

(VIII.)

Reactions with Solutions of Ferridcyanide of Potassium and Caustic Soda.—When this solution is added to ruthenium and iridum solutions, the following reactions are obtained:—

Ru_2Cl_3—bright yellow liquid.

$RuCl_2$—the same, but more on a wine colour.

Ir_2Cl_3.—When to a slightly acid solution of sesquichloride of iridium, enough of the solution in question in question is added to make the liquid strongly alkaline, a green colouration is produced at once, which by boiling becomes olive.

But if the iridium solution be first rendered alkaline with ammonia, the addition of the above reagent gives a bright yellow colouration, which by boiling becomes a deep wine red.

(IX.)

Reactions with Schlippe's Salt.—A solution of Schlippe's salt mixed with an equal bulk of ammonia, and added to the solutions of the Pt metals gave the following reactions:—

Ru_2Cl_3 by boiling, a blackish precipitate.

$RuCl_2$.—When the solution containing the bichloride of ruthenium is boiled, and a single drop of solution of Schlippe's salt is added, a yellow transparent liquid is obtained. A larger addition gives an abundant light brick-coloured precipitate. When this larger quantity of solution of Schlippe's salt is added a slight warming is sufficient to throw down the precipitate.

Ir_2Cl_3.—A similar precipitate is obtained, but only after some minutes' boiling.

$IrCl_2$ is instantly decolourised by solution of Schlippe's salt with ammonia, and when boiled remains clear for a few minutes then lets fall an abundant brick brown precipitate. In this it is distinguished from $RuCl_2$, which lets fall the precipitate by a slight warming.

PdCl.—As ammonia precipitates palladium at once, the following course was adopted. Ammonia was placed in a test-tube, and a little palladium solution added. Heat was applied till the precipitate which at first formed was redissolved. An addition of Schlippe's salt then produced an instantaneous and abundant brown black precipitate.

$PtCl_2$ treated with Schlippe's salt, without ammonia, gave an immediate dark brick brown precipitate in the cold.

$KOOsO_3$.—Osmite of potash, dissolved in dilute caustic potash, gives with the aid of heat an immediate black precipitate with Schlippe's salt.

The following substances gave no characteristic reactions with the platinum metals:—Fulminurate of ammonia, nitro-prusside of sodium, picrate of ammonia, nitrosalycylate of potash, purpurate of ammonia, benzoic acid, chloranilamate of ammonia.

The new reactions which I have described in this paper include characteristic criteria for all those cases in which it has been considered most difficult to discriminate. Platinum and rhodium offer no difficulties. The first can always be recognised with ease by its behaviour with chloride of potassium, and the latter by its behaviour with caustic alkalies. For the other metals I propose here very briefly to recapitulate what I consider the chief points of interest here developed.

Ru_2Cl_3.—The characteristic reaction of sesquichloride of ruthenium is its beautiful colouration when boiled with hyposulphite of soda. See section third.

$RuCl_2$.—Bichloride of ruthenium is recognised by its rose-coloured precipitate with ammonio-chloride of zinc, as described in section seventh.

$\left.\begin{array}{l}Ir_2Cl_3\\IrCl_2\end{array}\right\}$ Iridium is best detected by its behaviour with protochloride of tin and potash. The details and mode of application have been already described in section sixth.

PdCl.—The reaction of protochloride of palladium with tetrathionic acid is highly characteristic, and cannot well be confounded with any other. See section fourth.

For ascertaining the purity of solutions of iridium, particularly as respects ruthenium, the hyposulphite of soda is especially valuable, as described at the end of section third.

Analysis of the Water of Llandudno, North Wales, by Dr. SHERIDAN MUSPRATT, *M.D. (Hon.), F.R.S. Ed., &c., Founder and Principal of the College of Chemistry, Liverpool.*

LLANDUDNO having become of late years one of the most celebrated places of resort for the invalid or valetudinarian, some curt details relative to it may not prove uninteresting to your readers. The town is built under the shelter of the Great Orme's Head, encircling which vast structure a walk has been completed (distance round about five miles) affording peculiarly magnificent marine prospects; the inland views include the Vale of Conway and the majestic line of the Carnarvonshire hills. The cliffs of this immense headland are very steep, and are hollowed into caverns by the action of the sea; its sides form a range of mural precipices, and the summit a table-land. The rock is carboniferous limestone. Fossils are abundant, and the masses of petrifaction of sand, shells, fishes, &c., are evidence of the crag having been elevated by means of eruptions from the action of internal forces. There is embedded, in the centre of this huge mountain, copper ore. Cupriferous mines are about half a mile from the springs, and the water has been drawn from these 100 yards below.

A matter of the utmost importance to be considered in estimating the salubrity of a climate consists in its water. Llandudno is furnished with this essential to life from the west side of the Great Orme; and last summer a spring on the east lateral was added. The supply is constant, but of course fluctuates. There is a great deal more water in winter than in summer. It is brought to the town in iron conduits by its own pressure (no machinery). The date of its introduction was March 31, 1858. Previous to this the inhabitants were supplied from different springs, and some carried water from the sources that now flow into the town.

The water is excellent, as will be seen from the subjoined analysis just completed. Its inorganic constituents consist principally of chalk and common salt, both of which are tonic and stimulating, and act, therefore, beneficially:—

	Grains in the Imperial Gallon.
Carbonate of lime, $CaOCO_2$ . .	7·329
Carbonate of magnesia, $MgOCO_2$.	0·336
Carbonate of soda, $NaOCO_2$ . .	1·310
Carbonate of iron, $FeOCO_2$ . .	0·176
Sulphate of lime, $CaOSO_3$ . . .	2·448
Chloride of sodium, NaCl . . .	3·508
Chloride of magnesium, MgCl . .	2·550
Silicate of soda, $NaOSiO_2$ . . .	0·620
Nitrate of soda	traces.
	18·277

It is singular that a portion of the residue submitted to the spectroscope, gave no indications of any of the rare metals. The iron found no doubt arises in part (if not wholly) from the pipes through which the water passes. The presence of a *nitrate* in this water is somewhat significant.

Researches on Picrotoxine, by M. L. BARTH.

THE poisonous substance picrotoxine is remarkable from the fact that it contains no nitrogen. To the already known properties of this matter the author adds its solubility in heated fatty matters.* Its solution in alkalies turns to the left the plane of polarisation of light.

Cocculus Indicus contains besides picrotoxine another substance, distinguished by its slightly acid properties; this acid, which may probably be the menispermic acid of Boullay, is little soluble in water, alcohol, and ether, but considerably so in soda, whence acids precipitate it in a crystalline state. This acid is free from nitrogen, and in composition corresponds to the crude formula

$$\text{Ꞓ}_9H_{12}\Theta_5.$$

The author believes that the formula $\text{Ꞓ}_{12}H_{14}\Theta_5$, may be ascribed to picrotoxine itself. This formula cannot be controlled, as picrotoxine forms no definite combinations.

When an alkaline solution of picrotoxine is boiled, a modification takes place in the same way as when in presence of acids. By operating in presence of sulphuric acid, and then saturating with carbonate of baryta, the filtered liquid leaves on evaporation a syrupy mass containing a barytic compound soluble in water and in alcohol; the latter solution on evaporation leaves a brilliant varnish. The composition of this compound is

$$\text{Ꞓ}_{12}H_{10}Ba\Theta_8.$$

If the boiling is prolonged for thirty hours the composition of the barytic combination changes to

$$\text{Ꞓ}_{12}H_{17}Ba\Theta_7.$$

The barytic compound, when isolated, forms a gummy mass, soluble in water and alcohol, the solutions having an acid reaction. Dried at 130° this matter presents the composition $\text{Ꞓ}_{12}H_{16}\Theta_6$; it thus represents picrotoxine plus a molecule of water, $H_2\Theta$.

Picrotoxine treated by an excess of bromine gives a mass soluble in alcohol, from which it deposits as a soft crystalline mass.

The alcoholic solution of this body is precipitated by water, it is a product of the substitution of picrotoxine; its composition is,—

$$\text{Ꞓ}_{12}H_{12}Br_2\Theta_6.$$

Nitropicrotoxine.—Nitropicrotoxine is prepared like nitromannite; water precipitates it from the acid liquid, in the form of a flaky mass, soluble in alcohol, whence it is deposited in small needles. Nitropicrotoxine does not detonate with heat, but it decomposes at 100°. Its composition is explained by the formula

$$\text{Ꞓ}_{12}H_{13}(Ni\Theta_2)\Theta_5.$$

The author has vainly endeavoured to analyse picrotoxine; he thinks it may be regarded as a species of sugar, indeed, it reduces alkaline solutions of copper, fixes water by prolonged boiling with acids, and gives oxalic acid when treated by nitric acid. Heated with caustic lime it gives an oleaginous liquid, in odour resembling metacetone.

The author has endeavoured to make hydriodic acid react on picrotoxine, but only obtained some products which were very difficult to purify, and in quantities too small to admit of their being studied.

He also tried to produce an acid analogous to that derived from sugar of milk, by means of bromine and treatment by oxide of silver; the result was a small quantity of an acid amorphous body, soluble in water, with a flavour both acid and bitter, precipitable by subacetate of lead, and forming with lime a crystallisable salt.—*Bulletin de la Société Chimique.*

Analysis of Milk, by MM.* E. MILLON *and* A. COMMAILLE.

Method of Analysis.—It is impossible to doubt the necessity of adding a given volume of water to milk about to be analysed, since, without this precaution, the separation of the albuminoid matters becomes a tedious, difficult, and often impracticable operation. Measure twenty cubic centimetres of milk, dilute with four volumes of water, then add five or six drops of acetic acid. Shake, to effect a complete mixture, and a coagulum will immediately form, floating freely in the mass of the liquid. This coagulum gives butter and caseine.

The liquid gives albumen, lactoproteine, sugar of milk, and salts.

Throw the coagulum on a filter, and set it on one side the liquid which passes rapidly from it.

Wash the coagulum three or four times on the same filter, with as little water as possible, as too much water would dissolve traces of caseine. After distilled water use water and alcohol, and throw away the whole of the washings. The alcohol and water make the coagulum contract, so that it can be removed from the extended filter without the least loss.

Analysis of the Coagulum.—Butter and Caseine.—Detach the coagulum from the filter, and press between blotting paper, then distribute it in anhydrous alcohol; throw the whole on a filter, replace the liquid which runs through by ether, to which has been added one-tenth of absolute alcohol, and continue the washing with this mixture so long as any fatty matter is carried through. The fatty matter is all removed when the etherial liquid which creeps up the tube of the funnel evaporates without leaving the least trace of grease. The addition of alcohol to the ether is for the purpose of impeding the too rapid flow of this liquid, and consequently prolonging its contact with the caseum.

Butter.—Mix the alcoholic and etheral liquids in a weighed glass capsule, drive off the liquid by heating in a water bath, and weigh the butter.

Caseine.—The residue, undissolved by anhydrous alcohol and ether, is entirely composed of the caseine contained in the twenty cubic centimetres of milk coagulated by acetic acid; the rapid evaporation leaves after a few minutes purely white, dry, pulverulent caseine, which may be weighed without the least difficulty.

In cow's milk we have observed very little difference in the weight of caseine, notwithstanding differences in race and feeding, the weight of this substance having varied only 33·50 gr. to 36·83 gr. per litre.

Caseine is doubtless the least variable principle in the composition of milk, and this fact is of importance when we consider how difficult it would be to imitate the properties of this matter, and to replace it by some spurious addition.

Whey.—Albumen, Lactoproteine, Sugar of Milk, Ashes.—Divide the whey, separated by filtering, from the coagulum into three portions—one serves to

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* This a well-known fact.

* *Comptes Rendus*, lix., 396. 64.

determine the albumen and the lactoproteine, another the sugar of milk, and a third the ashes.

Albumen.—Take 35 to 40 cubic centimetres of diluted whey, boil the liquid in a small glass flask, shaking it constantly, so as to prevent the albuminous coagulum produced by the heat from adhering to the sides. When the liquid boils throw it on a filter and wash the coagulated albumen first with water, then with alcohol, and finally with ether; spread out the filter, and the coagulum may then be removed in one piece; place it in a weighed watch-glass, and dry it at 100° C.

By operating as above, we found that cow's milk contains on an average 5 gr. 25 of albumen per litre; goat's milk, 6·43 gr.; ass's milk, 11·83 gr.; and human milk, 10·88 gr.

Lactoproteine.—Return the whey, boiled and separated from the albumen, to the washings of the same operation; pour into this liquid two or three drops of mercuric nitrate very carefully prepared. The proteic matter will combine with 1 equivalent of oxide of mercury HgO, forming a precipitate which will re-dissolve in an excess of the mercurial salt, or even nitric acid. Collect this compound, wash it once with water acidulated with a hundredth of nitric acid, then with pure water as long as sulphuretted hydrogen produces a colouration, then again with alcohol, and finally with a little ether. The product then dries very easily, after which weigh it, and deduct 20 per cent. for the oxide of mercury, the rest gives the weight of the lactoproteine.

Sugar of Milk.—In the second portion of the whey estimate the sugar of milk by M. Barreswil's process. This method is so well known that a description of it is needless.

To determine the value of the cupro-potassic liquor we very carefully prepared and purified sugar of milk; we express its reducing power by 137·5, a number deduced from numerous trials. We found, in fact, that 137·5 of sugar of milk reduces exactly the same volume of Barreswil's liquid as 100 of cane sugar.

From six analyses of cow's milk we deduced an average of 44·24 gr. of sugar of milk per litre, the difference in the extremes being from 41·64 gr. to 48·46 gr.

Ashes.—The volume of the third portion of the whey should be about 25 cubic centimetres; evaporate it in a weighed platinum capsule over a naked fire for three-quarters of the liquid, and finish the evaporation in a water bath. When, after two successive weighings, the weight of the residue no longer varies, ignite it over a spirit-lamp, and the ashes will be obtained under these conditions without any difficulty. We endeavoured to ascertain whether caseine and butter take with them any considerable quantity of saline matter, and found that their combustion did not leave an appreciable quantity of ash.

The residue of the evaporation of whey contains before incineration, besides albumen, lactoproteine, sugar of milk, and ashes, various organic acids, the weight of which may be estimated by difference, though all the coexisting principles have been determined by a special operation; we have not tried to estimate them in any other way.

Odour of Milk.—Shaking new milk with three or four volumes of pure sulphide of carbon gave a curious result; on the liquid being allowed to stand the sulphide separates, without dissolving the butter, but charged with an aromatic matter. And by allowing it to evaporate spontaneously, an unctuous residue remains, almost imponderable, and possessing a high degree of the aroma contained in the food of the animal producing the milk. Generally, this is the fragrant odour of fodder, but sometimes also the odour is disagreeable, owing to the ingestion of nauseous-smelling plants, and sometimes it is rancid, from the decomposition of the food.

Cow's milk only has this peculiarity; that of the goat, for instance, gives no means of discovering the nature of the food; the slight residue left when this milk is treated with sulphide of carbon being perfectly inodorous—at least, we have hitherto found this to be invariably the case.

Colour of Milk.—Another characteristic of cow's milk is shown when the separation of butter is effected in the galactometer; the fatty matter which, in the assay tube, floats on the surface of the liquid, is always of a yellow colour; we have found no exception to this, which may, however, depend upon the mode of feeding; but from goat's, sheep's, woman's, and ass's milk we have not less invariably isolated a perfectly colourless butter.

Action of Alkaline Hyposulphites on Chromates of Potash and Ammonia, by M. E. Kopp.

ALKALINE hyposulphites in presence of chromates render very evident the difference of oxidising energy between bichromates and neutral chromates. While the first, especially if assisted by heat, react immediately on the hyposulphite, the latter remain for almost any length of time in contact with this salt without any alteration taking place either in the chromate or the hyposulphite. Hence we may predicate the result of mixing solutions of potassico-ammonic chromate and hyposulphite of soda.

When cold nothing happens, the liquid remains yellow; even on boiling there is at first no sign of decomposition; but gradually, as the ammonia is disengaged, and the neutral chromate changes to bichromate, the reaction begins, the liquid becomes cloudy, and leaves a more or less abundant deposit of chromic superoxide, varying in tint from brownish-yellow to very dark brown, according to the concentration of the liquids and the duration of the boiling.

The following experiments show this mode of decomposition.

In four flasks dissolve in 500 cubic centimetres of distilled water the following mixtures, and boil them for three hours without replacing the evaporating water:—

(*a*) 10 gr. $Cr_2O_6 . KO$ and 8 gr. 21 $S_2O_2NaO + 5$ aq.
(*b*) 10 $Cr_2O_6 . KO + 8·21\ S_2O_2NaO + 5$ aq. + excess of ammonia.
(*c*) 10 $Cr_2O_6 . KO + 8·21\ S_2O_2NaO$ 5 aq. + 5·25 sal ammoniac + excess of ammonia.
(*d*) 10 $Cr_2O_6 . KO + 8·21\ S_2O_2NaO$ 5 aq. + 5·24 sal ammoniac.

The following phenomena were observed:—

(*a*) As soon as the salts were dissolved by the addition of hot water the solution became darker and darker, passing from orange to yellowish brown. Then the liquid became cloudy, a dark cinnamon-brown precipitate formed, becoming more abundant as the boiling proceeded.

However, at the end of the experiment, by collecting the precipitate on a filter and washing it rapidly with cold water, it was found that the mother liquors were still strongly coloured yellow, and contained a notable portion of neutral potassic or sodic chromate.

(*d*) Behaved like *a*, except that the mother liquor was barely coloured yellow, and that the precipitate was a little lighter. The more complete decomposition of the chromic acid was evidently produced by the addition of ammoniacal salt, and the mixture might then be considered as formed of chloride of potassium and ammonic bichromate, and nearly all the ammonia disengaging itself on boiling, the hyposulphite of soda was free to react on nearly all the chromic acid present.

(*b*) A yellow and limpid solution remaining unchanged, even after the commencement of ebullition; but as the ammonia was disengaged the liquid became disturbed, and formed a dark cinnamon-brown precipitate. On filtering the liquid was still of a brownish-orange colour, and on reboiling gave a certain quantity of precipitate. The mother liquors indicated only the yellow colour of neutral chromate.

(*c*) Behaved like *b*, only the precipitate was of a darker shade, and the mother liquors contained but traces of the undecomposed chromate.

On mixing the mother liquors of the four operations, and boiling them again for a long time, a fresh quantity of yellowish brown precipitate was obtained, rather lighter in colour than the others.

These precipitates may be considered as formed of chromic superoxide, CrO_2, or chromic chromate,

$$CrO_3.Cr_2O_3 = Cr_2O_6 = 3CrO_2.$$

In fact, they easily divide into chromic acid and oxide of chromium. We have been able to verify the correctness of the observation of MM. Elliot and Storer (*Répertoire de Chimie Appliquée*, 1861, p. 390), that by washing with water, especially with boiling water, the chromic superoxide constantly loses chromic acid, which dissolves, and the residue on the filter becomes richer and richer in oxide of chromium.

By boiling with caustic or carbonated alkalies, CrO_2 separates almost immediately into greenish insoluble hydrate of oxide of chromium and soluble alkaline chromate. This property may be utilised in making its analysis. Chromic superoxide may be put in contact with cold diluted acids without being dissolved or altered. The filtered acid liquid contains a small quantity of chromic acid and is generally yellow, while the precipitate is darker.

Hot hydrochloric acid easily dissolves it with production of a brown colour, and disengagement of chlorine; on evaporation there remains a green solution of chromic chloride.

When calcined, chromic superoxide, prepared by the action of hyposulphite of soda, disengages water and oxygen and leaves a dark, muddy, green residue of oxide of chromium.

Analysis of Chromic Superoxide.—The precipitates of the above operations washed as quickly as possible in tepid water (which constantly removed chromic acid) were placed on sheets of paper to drain, then wrapped in paper, and so left for about ten days to dry in the sun.

Qualitative analysis having shown the presence of small quantities of sulphuric acid in the precipitate, 5 gr. of it were dissolved in boiling hydrochloric acid, and the diluted solution was precipitated by chloride of barium. We obtained,—

For (*a*) 0 gr. 2040 So_3BaO corresponding to 0 gr. 07 SO_3 = 1·40 p. 100 So_3.

For (*b*) 0 gr. 2695 So_3BaO corresponding to 0 gr. 0925 So_3 = 1·88 p. 100 SO_3.

For (*c*) 0 gr. 1345 SO_3BaO corresponding to 0 gr. 046 SO_3 = 0·92 p. 100 SO_3.

For (*d*) 0 gr. 1825 SO_3BaO corresponding to 0 gr. 0625 SO_3 = 1·25 p. 100 SO_3.

After the excess of barytic chloride has been precipitated by a few drops of sulphuric acid, the filtered solution serves to estimate the quantities of oxide of chronium in the compound.

To estimate chromic acid one gramme of superoxide is dissolved in pure hot nitric acid; after sodic acetate and water are added to the solution, a mixture of sulphate and chromate of lead is precipitated by acetate of lead, and dried and weighed, and from it is deducted the sulphate of lead calculated according to the proportion of sulphuric acid already determined.

				Capable of losing by calcination. Oxygen.
(*a*)	furnishes 0 gr. 364	of CrO_3PbO	= 11·30 per c. CrO_3	2·70
(*b*)	,, 0 gr. 3365	,,	= 10·45 ,, ,,	2·50
(*c*)	,, 0 gr. 3930	,,	= 12·20 ,, ,,	2·91
(*d*)	,, 0 gr. 3720	,,	= 11·55 ,, ,,	2·76

Then calcine a certain quantity of each of these precipitates at dull red heat in a platinum crucible, and the losses will be as follows:—

		Water and Oxygen.
1·890 gr. of (*a*)	will lose 0 gr. 650	= 34·39 per cent.
1·238 gr. of (*b*)	,, 0 gr. 450	= 36·35 ,,
2·451 gr. of (*c*)	,, 0 gr. 858	= 35·00 ,,
2·310 gr. of (*d*)	,, 0 gr. 797	= 34·50 ,,

These data give to the different precipitates the following composition:—

	a	*b*	*c*	*d*
Sulphuric acid . .	1·40	1·85	0·92	1·25
Chromic acid . .	11·30	10·45	12·20	11·55
Oxide of chromium .	55·51	53·85	54·79	55·46
Water . . .	31·79	33·85	32·09	31·74
	100·00	100·00	100·00	100·00

These figures correspond to no formula.

Having observed that the precipitate formed in the liquid changed colour under prolonged boiling, some potassico-ammonic chromate was re-boiled to which ammonic chloride and a small quantity of sodic hyposulphite had been added. As soon as brownish yellow precipitate formed it was collected on a cloth filter, washed once with cold water, strongly pressed between folds of blotting-paper, and then dried in a water bath.

2 gr. dissolved in nitric acid furnish 1·762 CrO_3PbO equivalent to 0 gr. 546 CrO_3 or 27·31 CrO_3, capable of losing 6·52 of oxygen by calcination.

The same precipitate lost 37 per. cent of its weight by calcination.

The composition, then, corresponds approximatively to the formula $CrO_2 + 2$ aq. The result being

			Calculation.	Experiment.
Cr = 328 = 43·56	or, rather	Chromic acid .	27·31	27·31
O_2 = 200 = 26·56		Chromic oxide	42·21	42·21
2HO = 225 = 29·98		Water . .	30·48	30·48
100·00			100·00	100·00

After adding an excess of sodic hyposulphite to the mother waters, boil for an hour, and collect the yellowish-brown precipitate (1). After prolonged reboiling, a new precipitate forms (2) of a darker colour; then filter, and after again boiling a third precipitate forms, but of a bluish-grey colour, containing no chromic acid, but only hydrated oxide of chromium, contaminated with a little sulphuric acid and sulphur; the mother liquors become quite colourless.

Precipitates (1) and (2), after careful washing, were dried in the air and analysed; they contained but a trace of sulphuric acid, of which no notice was taken.

2 gr. of (1) furnished 0·852 of CrO_3,PbO = 13·56 per cent. CrO_3, being able to lose 3·24 of oxygen.

1 gr. 903 calcined lost 0·727; HO + oxygen = 38·20 per cent.

1·2 gr. of (2) furnished 0·332 CrO_3,PbO = 8·812 per cent., CrO_3 losing 2·105 of oxygen.

2 gr. 350 calcined lost 0·860 = 36·60 per cent.

These figures indicate the following composition. For the first precipitate (1):—

Water . . .	34·96	or, rather	Water . . .	34·96
Chromic acid .	13·56		Chromium .	42·41
Oxide of chromium . . .	51·48		Oxygen . .	22·63
	100·00			100·00

or, rather	Water . . .	34·96
	Oxygen . .	3·24
	Oxide of chromium . .	61·80
		100·00

These numbers correspond best with the formula $2CrO_3 + 5Cr_2O_3 + 28$ aq. In fact,

$$\begin{array}{rcrcr} 2CrO_3 & = & 1256 & = & 13{\cdot}67 \\ 5Cr_2O_3 & = & 4780 & = & 52{\cdot}04 \\ 28HO & = & 3150 & = & 34{\cdot}29 \\ \hline & & 9186 & & 100{\cdot}000 \end{array}$$

For the second precipitate (2):—

Water . . .	34·495	or, rather	Water . . .	34·495
Chromic acid .	8·812		Oxygen . .	2·105
Oxide of chromium . . .	56·693		Oxide of chromium . .	63·400
	100·000			100·00

or, better	Water . . .	34·495
	Oxygen . .	22·000
	Chromium .	43·505
		100·000

$$\begin{array}{rcrcr} CrO_3 & = & 628 & = & 9{\cdot}22 \\ 4Cr_2O_3 & = & 3824 & = & 56{\cdot}12 \\ 21HO & = & 2362 & = & 34{\cdot}66 \\ \hline & & 6814 & & 100{\cdot}00 \end{array}$$

These numbers may be approximately represented by formula $CrO + HCr_2O_3 + 21HO$.

In fact,

The result of all these data is that the compound $CrO_2 + 2$ aq. = $Cr_2O_4 + 4$ aq., by losing chromic acid at last gives hydrated oxide of chromium, having for formula $Cr_2O_3 + 4$ aq., and containing 32 per cent. of water of hydration.

If we have rather prolonged the analysis of the brown-yellow precipitate obtained under the circumstances described, though the compound is so liable to alteration and undergoes modification by simple washing in water, it is that we might give a better account of the nature of the body decomposed on the fibres of paper and cloth consequent on the reduction of chromic acid.

It remains for us to say a few words on the phenomena which takes place when, besides the reducing hyposulphite, there is associated with the potassico-ammonic chromate another salt, the acid of which will combine with oxide of chromium.

If, instead of making alkaline hyposulphite react alone on potassico-ammonic chromate, we at the same time add a certain quantity of another salt, with an energetic acid capable of forming an insoluble salt, with oxide of chromium, it is no longer chromic superoxide, but a salt which is precipitated.

Having boiled a solution of 10 gr. potassico ammonic chromate, 10 gr. crystallised hyposulphite of soda, 10 gr. crystallised phosphate of soda in one litre of water, reduction is gradually effected, and a pulverulent precipitate of a pretty green colour is formed (rather similar to Schweinfurth green much mixed with white).

By replacing the phosphate of soda by sodic arseniate, the precipitate was pulverulent, of a darker green, but at the same time more greyish.

By using yellow prussiate, the precipitate was light green pulverulent.

By using red prussiate the precipitate became olive green, gelatinous, and difficult to wash.

Similar results were obtained by adding ammoniacal salt to these solutions.

It is reasonable to suppose that these results may be applied to calico printing.

The following is the result of some experiments made for this purpose:—

Potassico-ammonic chromate, either alone or with the addition of ammoniacal salt, or what comes to the same thing, bichromate of potash dissolved in liquid ammonia (avoiding any excess), was dissolved in gum-water, and an equal weight of hyposulphite of soda was added.

The colour remains unchanged, even in the air, for almost any length of time.

By printing it on calico, and letting it dry slowly, it takes a warm, rich, cinnamon-brown tint.

By steaming and washing the tint becomes olive. It is then a true chrome mordant, for it may be washed and dyed with madder, dye-wood, &c.

It is to be regretted that the cinnamon-brown colour undergoes alteration by prolonged washing, by the action of water, soap, alkalies, since a very beautiful tint can be produced.

By adding phosphates, arseniates, alkaline prussiates to the colour, the designs likewise take a brown tint on drying; but if steamed this tint gives way to green tints, more or less dark or olive, according to the nature of the salt added.

These colours possess a fair degree of stability, and as green colours some of them are no doubt fit for various applications.

It is probable that the red prussiate green, with base of oxide of chromium (chromic ferricyanide) is uncertain when employed in large quantities, may be replaced by the vapour green prepared by the action of alkaline hyposulphites on ammoniacal chromate, in presence of red prussiate of potash.

One drawback to these chromate and hyposulphite colours is that they cannot be thickened with starch, for in a short time the mixed colour coagulates strongly. By thickening it with gum we have hardly ever observed any coagulation.

Action of Phosphorus on Potassic Bichromate, and on Potassico-ammonic Chromate.—By leaving a solution of these salts in presence of a rod of phosphorus during the summer, exposed to the direct rays of the sun, or by favouring the reaction by means of heat, a reducing reaction is quickly established, and in a few days the liquid contains only neutral chromate of potash and a light green precipitate. This is well washed and dried in the air.

It contains a considerable quantity of phosphoric acid. Indeed, after calcining it in a platinum crucible with an excess of carbonate of soda, dissolving in water, filtering, neutralising by hydrochloric acid, a few drops of the liquid are sufficient to produce in an ammoniacal solution of a salt of magnesia, a crystalline precipitate abounding in ammoniaco-magnesian phosphate.

This fact shows that after purifying phosphorus by a solution of bichromate of potash, it is not necessary to prolong the contact between these two bodies, or to avoid the influence of the direct rays of the sun.—*Moniteur Scientifique.*

Constant Battery to be Applied to the Manufacture of Magnesium, by Arthur Reynolds, *B.Sc.*

It has occurred to me that a constant and cheap battery might be made, by employing for an exciting liquid a solution of perchloride of iron, and for the metal to be attacked, metallic iron, the copper plate being replaced by carbon.

The most convenient form of the battery would be to have pots made of carbon for holding the liquid. Slits cut in a thick plate of gas retort carbon would do. The action of the battery would be quite constant, as the exciting liquid would always remain in the same condition, the iron dissolving by reducing the solution to protochloride, which being oxidised by the air would be deposited, so that the solution would always remain of the same strength.

This would be as cheap, or cheaper than any other form of battery, and perpetually constant, and the same acid would do for a long time.

The purpose for which I propose to employ the battery is, to the manufacture of magnesium from sea-water. The sea-water should be evaporated with a little chloride of calcium, and after the main bulk of the common salt and sulphate of lime has crystallised out, the solution should be evaporated to dryness, the dry mass melted, and decomposed by the voltaic battery before described. This process would be sure to succeed.

TECHNICAL CHEMISTRY.

A New Blasting Gunpowder, by M. H. Schwartz.

This powder is now largely employed in mining. Its combustion is slow, but complete. The following analyses show why it is cheaper than ordinary powder:—

	I.	II.
Soluble salts . .	74·55	74·32
Nitrate of potash .	56·22	56·23
Nitrate of soda .	18·30	18·09

The treatment by sulphide of carbon produced,—

Dissolved sulphur .	9·68	7·61
Carbon remaining .	14·14	15·01
Moisture. . .	1·78	11

It is a coarse-grained powder, in which one part of potash nitre is replaced by nitrate of soda.

In the first instance, one part of nitrate of soda for one part of nitrate of potash was used, but it was afterwards found best to employ a third of nitrate of soda.—*Bulletin de la Société Chimique.*

The Employment of Sulphide of Lead as a Decolorising Agent, by M. Graeger.

The use of animal charcoal for the decolorisation of solutions of vegetable acids presents frequent difficulties on account of the solubility of phosphate of lime. The author has therefore endeavoured to replace animal black by other matters, and has found that sulphide of lead can be very advantageously employed in the manufacture of tartaric acid. When solutions of tartaric acid are decolorised with bone black, the first crystallisation generally gives colourless crystals, while those from the mother liquor are covered with a white coating of tartrate of lime, and have to be redissolved with the addition of sulphuric acid to the liquid. The employment of sulphide of lead necessitates some simple precautions. The sulphide should be perfectly free from sulphate, which is soluble in tartaric acid; it must consequently be prepared in the presence of an excess of alkaline sulphide. The author decomposes acetate of lead by sulphide of sodium. It is not sufficient that the supernatant liquid should be free from lead, as there might in that case remain some sulphate of lead, produced by oxidation of sulphide, in the precipitate, but there must be an excess of alkaline sulphide.[*] Though there is a slight disengagement of hydrosulphuric acid during the boiling of solutions of tartaric acid with sulphide of lead, the author has ascertained that the liquids remain free from this metal. Solutions thus decolorised always give colourless and transparent crystals.—*Bulletin de la Société Chimique.*

PROCEEDINGS OF SOCIETIES.

PHARMACEUTICAL MEETING.

Wednesday, January 4.

Mr. Sandford, *President, in the Chair.*

The first paper read was by Dr. Attfield, and entitled "*Notes on Perchloride of Iron and its Pharmaceutical Preparation,*" a report of which is deferred until next week.

The next paper was by Mr. Balmanno Squire, "*On a New Form of Ointment of Stavesacre, and its Application in certain Skin Diseases.*" Mr. Squire believes that the intractable skin disease known as prurigo senilis is the consequence of the presence of the common louse, *pediculus corporis*, and that the best thing for getting rid of the parasite and curing the disorder is an ointment of stavesacre. But stavesacre seeds contain a good deal of oil, and are difficult to powder, and ointment made from the crushed seeds is an inconvenient and inelegant preparation. Dr. Squire has found, however, that the oil expressed from the seeds contains all the active properties, and when mixed with lard and a little white wax, to give consistence, it makes an excellent and useful ointment. A preparation nearly as effective, but not so white, can be made by digesting the crushed seeds in hot lard for some hours, and then straining. This ointment, though not so good as the former, is very useful for itch.

Professor Bentley then announced an interesting discovery lately made by Dr. Daniell. It was the presence of *theine in the kola nut*, the fruit of the kola or sterculia acuminata, an article used extensively as food by the natives of Central Africa. This, the Professor said, was a very important discovery, since it added one more order of plants to those already known to contain the alkaloid. But, since the kola belongs to the same, or an order very closely allied to that which included the cocoa, he thought the alkaloid might perhaps be found to be theobromine.

Dr. Attfield showed on a watch-glass some of the alkaloid which he had extracted from the nuts, forwarded by Dr. Daniell. The crystals resembled so exactly those of some theine extracted from tea, for the sake of comparison, that the Doctor said he had no doubt the alkaloid was theine, and not theobromine.

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[*] The acetate of lead may be replaced by sulphate, which is found as a waste product in print works, and is very cheap. But the use of sulphide of lead for the decolorisation of tartaric acid seems not to be without difficulties, as by contact with the air this body oxidises, and is transformed into sulphate. To avoid this, it must always be used directly it is prepared.

It was announced that, at the next Pharmaceutical meeting, a paper, by Dr. Daniell, on the subject would be read, and also a paper, by Dr. Attfield, on the analysis of the nuts.

The next paper was "*On the Purification of the Essential Oil of Bitter Almonds*," by Mr. W. A. **Tilden**. Of the processes hitherto in use for separating prussic acid from oil of bitter almonds, no one is quite efficient and satisfactory, and the author's object was to find a method free from the objections brought against those commonly employed. One process proposed was founded upon the splitting up of hydrocyanic acid into formic acid and ammonia with the assistance of the elements of water. This change is effected by the intervention of a strong mineral acid. But in the presence of hydride of benzoyl formic acid is not set at liberty, but it unites with the elements of the hydride to form a conjugate acid—formo-benzoylic acid. The formation of this acid necessarily involves a loss, which is sometimes considerable. Mr. Tilden's object was to devise a process for the destruction of the hydrocyanic acid, which would not involve the production of the formo-benzoylic acid, and so avoid the loss mentioned. In this he had succeeded, to a certain extent, by following the method now described. The crude oil was mixed in a flask with three times its bulk of hydrochloric acid a little diluted, and then distilled. As soon as the oil began to pass freely more water was added, and the distillation proceeded with. A mixed distillate of oil and acid water was obtained, from which the oil was separated and rendered neutral by means of quicklime. Hydrate of lime must not be used, since it discolours the oil. Theoretically 8 per cent. of hydrocyanic acid in the oil would in this process occasion a loss of 31·4 per cent. of the hydride, and 5 per cent. of hydrocyanic acid would cause the removal of 19·6 per cent. of hydride. The author, however, has made two quantitative experiments, and believes that on the large scale the average loss would not exceed 17 per cent., which loss would include the hydrocyanic and benzoic acids, and other impurities. Another and better process had been suggested to the author by Mr. Broughton, who had thought that, since the hydride of benzoyl is to be regarded chemically as the aldehyde of the benzoyl series, it could be freed from its impurities by taking advantage of the general property possessed by all aldehydes of forming a definite crystalline compound with an alkaline bisulphite. The plan succeeded perfectly. The crude essential oil is to be shaken with an equal volume of a strong solution of bisulphite of soda. The mixture becomes warm, and the essential oil is all converted into a crystalline mass. This is drained, dried, then dissolved in a small quantity of water, and distilled with carbonate of soda.* In this process no loss is experienced beyond the impurities, and the hydride is obtained absolutely pure. To preserve it so it is essential that it should be perfectly dry, and it is advisable to rectify with chloride of calcium. The pure hydride oxidises to benzoic acid with great facility, and the oxidation is more rapid in the presence of moisture. The crude essential oil was much more permanent, the reason for which was not perfectly known.

Dr. **Redwood** said that he had worked upon the same subject, but had never obtained completely satisfactory results. It was easy to remove the prussic acid by means of oxide of mercury, but it was an object to avoid loss, and also to ensure the permanency of the pure oil. Dehydrating the oil was successful to some extent, but the oil was never used unless diluted with spirit which contained some water, and this favoured rapid oxidation, by which the solution lost much of its flavour. As the crude oil was so much more permanent, it was advisable to try and find out some combination which would resemble the crude oil. The hydrocyanic acid in the oil was not all present in the free state, and Liebig had shown that the whole amount was not at once precipitated by mercuric oxide. The combined hydrocyanic acid might act as the preservative agent, and perhaps an innocuous acid, like hydrochloric, would answer the same purpose.

Mr. **Tilden** remarked that the hydrocyanic acid did not exist in the oil as a cyanide. It was probably furnished by benzamide.

Mr. **Allchin** said it was important to devise some means of preserving the oil, since the spirituous solution so quickly oxidised that he had had some returned to him quite destitute of flavour. The substitution of some other radical for cyanogen would, perhaps, effect the purpose.

Mr. **Haselden** followed up some remarks of Dr. Redwood, who had observed that the paper read had been brought from the Chemical Discussion Society, which had proved a valuable auxiliary in bringing papers before the Pharmaceutical meetings. Mr. Haselden regretted the scanty attendance of the members at the meetings, for the younger members, who often took a good deal of time and trouble in preparing their papers, required and deserved more encouragement than they received.

(To be continued.)

ACADEMY OF SCIENCES.

January 2, 1865.

M. **Déclat** contributed a memoir "*On the Use of Phenic Acid in Medicine.*" The author dwelt principally upon the action of phenic acid as a local application to sloughing wounds, on which the action of the acid appears to be most remarkable. He also mentions a case of epithelial cancer of the tongue, in which it appears to be effecting a perfect cure. As an injection in some affections of the bladder and the genito-urinary organs, it also seems to produce most beneficial effects. In obstinate eczema and other skin diseases, a lotion of the acid appears to be most useful; while as a general and local disinfectant it seems unequalled. Lastly, he mentions two cases of croup, in which the effects were most striking.

A letter from M. Berthelot, "*On Alcoholic Fermentation*," gives some striking and original views of the nature of sugar. These are derived from the consideration of the amount of heat furnished by the combustion of sugar, and also by its possible constituents. The author starts with the proposition that the bodies whose decomposition is attended with the disengagement of heat should, in his opinion, be divided into two classes: 1, those whose formation, regarded independently of all other phenomena, is attended with *positive work*, disengagement of heat; and 2, those whose formation is accompanied by *negative work*, absorption of heat. It concerns us to know to which of these classes sugars belong. The solution of this question depends upon the manner in which sugars may be formed by means of their elements, this formation being considered independently of all the other reactions which may accompany it. Glucose, $C_{12}H_{12}O_{12}=180$, may, for example, be formed by the following groupings, among others, and the combustion of 180 grammes of these will give the amount of heat attached. (The unit is the amount of heat that will raise a kilogramme of water 1 degree.)

Grouping of the Elements.		Corresponding heat of Combustion.
Carbon and water,	$C_{12}+H_{12}O_{12}$ . .	. 576
Carbonic acid and marsh gas,	$3C_2O_4+3C_2H_4$.	. 630
Carbonic acid and alcohol,	$2C_2O_4+2C_4H_6O_2$.	. 652
Carbonic oxide and hydrogen,	$6C_2O_2+6H_2$.	. 804
Formic acid and hydrogen,	$6C_2H_2O_4+6H_2—6H_2O_2$	980

On the other hand, the author calculates from the numbers given by Dubrunfant for the heat disengaged in the

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* This process is described in "Gmelin's Handbook," vol. xii., p. 24; but we do not dispute the originality of Mr. Broughton's idea.

alcoholic fermentation, and those given by Favre and Silbermann for the combustion of alcohol, that the heat of the combustion of sugar should be near 726. If sugar results from the association of carbon with the elements of water, or the association of the elements of alcohol with those of carbonic acid, the alcoholic fermentation will be comparable with the destruction of oyygenated water or of formic acid. But sugar may equally be formed by the union of hydrogen with the elements of carbonic oxide or formic acid; and the latter appears the more probable, since the effect of light on the respiration of plants—the primary origin of the formation of sugars—is to decompose at once both carbonic acid and water. If this view be correct, the alcoholic fermentation will be essentially a true combustion, giving rise to carbonic acid by virtue of an internal reaction comparable to the combustion of free carbon by free oxygen. The amount of heat disengaged at the moment of the formation of carbonic acid at the expense of the carbon and oxygen combined in the sugar is equal to about two-fifths of the heat that would produce the formation of the same amount of carbonic acid at the expense of the free elements,—a result it may be useful to note in considering the theory of animal heat. However it may be, the number 726 measures (inversely) the labour expended by solar light in transforming water and carbonic acid into sugar. The difference between this total and the heat of the combustion of alcohol—that is, 74—gives approximately the measure of the work necessary to be expended in reconstituting sugar by re-uniting carbonic acid with alcohol; in other words, re-uniting the products of the alcoholic fermentation.

M. Hugo Schiff presented a note "*On the Action of Aldehyds upon Amines.*" With œnanthic or benzoic aldehyd and amylamine, the author obtained diœnanthylidene-diamylamine and ditoluydene-diamylamine. The author submitted many amines to the action of aldehyds, and the general result of his researches is, that in every instance the typical hydrogen of the base is completely removed by the oxygen of the aldehyd, and replaced by the biatomic residue of the latter. In this way the aldehyds offer a new and easy means of determining the number of the equivalents of typical hydrogen. This reaction is preferable to that of hydriodic and hydrobromic ethers, because with these each equivalent of hydrogen requires a fresh treatment, while with the aldehyds one experiment suffices for all. In many cases the typical hydrogen may be determined by a simple volumetric experiment, pure œnanthol being employed, and a burette divided into 20ths of a cubic centimetre. The œnanthol must be added to the base, slightly heated, so long as water is eliminated.

MM. H. Schiff and E. Bechi also contributed a note "*On Ammoniacal Cyanide of Copper.*" The object of the note was to correct some mistakes of M. Lallemand; but, as we did not publish that paper, it is only necessary to give the results of the present communication. Dry cuprous cyanide absorbs dry ammonia, and a white powder, cyanide of cuprosonium,

$$N\left\{\begin{matrix}H_3\\ \text{Ɵ}u\end{matrix}\right\}Cy$$

is produced. While dry this powder does not change in the air; but if moistened with water or ammonia it becomes violet. When cuprous cyanide is boiled with ammonia in the air, oxygen is absorbed, and violet crystals are obtained, which consist of the above cyanide of cuprosonium, with a small amount of cyanide of cupriconium.

$$N_2\left\{\begin{matrix}\text{Ɵ}u''\\ H_3\\ H_3\end{matrix}\right\}Cy_2.$$

The authors are inclined to believe all the violet salts mixtures of two cyanides. A chemical compound of the above two salts gave beautiful deep green crystals, which had the composition $N_2H_6\text{Ɵ}uCy_2,4NH_3\text{Ɵ}uCy$. There was found at the same time a deep blue-coloured salt, which decomposed on being dried, losing ammonia.

NOTICES OF BOOKS.

Chemical, Natural, and Physical Magic, intended for the Instruction and Entertainment of Juveniles during the Holiday Vacation. By Septimus Piesse, Ph.D.; F.C.S., &c. Longman and Co. London. 1865. Third Edition.

Dr. Piesse, writing for his own children, he says, adds, as they grow older, matter which requires more and more mental labour to understand. These additions, he trusts, will make this edition of his book more entertaining. We have our doubts about this, and are inclined to believe some of the additions neither entertaining nor instructive. There is much, however, in the book to interest and excite the attention of intelligent children, and to these it will furnish both instruction and entertainment during their "holiday vacations."

A Manual of Diet and Regimen for Physician and Patient. By Horace Dobell, M.D., &c. London: Churchill and Sons. 1864. (Second Edition.)

We are half disposed to be as sorry for the medical man as the patient who requires this book; and yet there is no denying that to some it may be a very useful publication. A physician has often little to do beyond prescribing a patient's dinner; and it will answer his purpose very well, and amuse the patient besides, if he gets one of these little books and adopts the author's suggestions. Here is a list of all sorts of foods and drinks, and the doctor has only to write "No," "Yes," and "Yes, especially!" opposite them in order to give his patient a complete guide as to what to eat, drink, and avoid. Besides this, the author has taken a good deal of trouble to calculate a series of normal diet tables for a healthy adult man, founded upon the assumption that such a character requires daily fixed and definite proportions of certain materials to keep his machinery going. From these tables we learn that 25 ozs. of bread, 3½ ozs. of cheese, and 2 ozs. of butter, are very nearly the nutritive equivalents of 6 ozs. of cooked meat, poultry, or game, 4 ozs. of fish, 10 ozs. of bread, 8 ozs. of potatoes, 2 ozs. of rice, 2½ ozs. of sugar, 2½ ozs. of butter, with 5 ozs. of milk and some tea and coffee. Sixteen ounces of oatmeal, with 22 ozs. of milk, with 1¼ ozs. of butter, and ¼ of an ounce of sugar, have an equal value; which teaches us that we have no occasion to waste pity on people who live on bread and cheese or porridge, supposing they get enough of it.

Another table gives the alcoholic and other contents of most ordinary spirituous liquors; and the author directs them to be prescribed according to the amount of absolute alcohol the physician will allow his patient. But we believe most physicians know that the effects of these fluids are by no means measured by the amounts of alcohol they contain. A series of excellent rules for promoting and maintaining vigorous health are prefixed to the tables. They relate to clothing, sleep, exercise, meals, &c., and we are glad to find that in one the author endorses a suggestion we lately saw extracted from an American paper—viz., "If your business obliges you to go out before breakfast, have some breakfast first."

Journal für praktische Chemie, No. 20, 1864.

This number opens with an interesting paper by Deichsel on "*Mesoxalic Acid.*" The author describes the already known methods of obtaining this acid for alloxan, and then gives an account of several of its salts. He further investigated the product of the reduction of the acid by means of sodium amalgam, and found tartronic acid. Dr. A. Baeyer, in a paper "*On the Synthesis of Aceconitic Acid from Acetic Acid,*" describes two new acids obtained by treating bromacetic ether with sodium. The crude product of the action of these two bodies is a dirty brown mass, which blackens in the air. Distilled in a vacuum above 200° C. the mass yields an ether, or rather two ethers, the mixture of which offers great resemblance to aconitic ether, but which is really the ether of two new acids, *aceconitic*, $C_6H_8O_6$, or $C_3H_5.C_3{O_3 \atop H_3}\Big\}O_3$ and *citracetic*. The salts of the latter acid will not crystallise, and the author has not yet determined the formula. Both are tribasic acids. A short note on "*Oleic Acid*," by Burg, describes some of the products of the action of bromine on that, and also on elaidinic acid. Jaffé also describes bromangelic acid. The next paper is by Professor Barfoed, of Copenhagen, "*On Sulphide of Mercury and some Basic Sulphur and Mercury Salts.*" We give the author's *resumé*:—1. The black precipitate formed when a mercurous salt is treated with HS or colourless sulphide of ammonium, is not Hg_2S, but a mechanical mixture of mercury and sulphide of mercury. 2. The black precipitate, therefore, is acted on by nitric acid. By treatment therewith the mercury is oxidized as usual to mercurous or mercuric nitrate, according to circumstances, and in the latter case the whole precipitate is converted into a basic sulpho-nitrate of mercuric oxide, $HgONO_5+2HgS$, which remains undissolved, and mercuric nitrate, which dissolves. 3. The basic sulpho-nitrate, which can be formed in several ways besides the one here described, is nearly insoluble in nitric acid. By hydrochloric acid it is converted into basic sulpho-chloride, which contains more sulphide of mercury than $HgCl+2HgS$, but by heating this is quite decomposed, and dissolves with separation of sulphur and the formation of sulphuric acid. By means of the strongest sulphuric acid it is converted into basic sulpho-sulphate of mercuric oxide, HgO,SO_3+2HgS. By sulphuric acid specific gravity 1·84, it is decomposed into mercuric sulphate with evolution of sulphurous acid. 4. Black sulphide of mercury is under ordinary circumstances insoluble in nitric acid, and not visibly attacked. But by long-continued heating it is at last converted into white basic sulphonitrate, and sulphuric acid which dissolves a trace of mercury. 5. The sulphide of mercury is insoluble in sulphydrate of sulphide of sodium. Dissolved in sulphide of sodium it is again precipitated by sulphuretted hydrogen. Our readers will see that these are important facts bearing on the separation of mercury by the ordinary analytical methods, and we shall return to the paper. The last paper is by R. Weber, "*On a Compound of Chloronitrous Acid with Sulphuric Acid.*" Chloronitrous acid gives with anhydrous sulphuric acid a white crystalline compound, answering to the formula $2SO_3+NO_2Cl$. The dry vapours of the two are brought together in a well cooled flask. The sides of the flask soon become covered with an oily liquid, which as it gets colder solidifies into a crystalline mass, resembling in appearance stearic acid. The mass fuses without decomposing. At a higher temperature it gives off vapours, and on being distilled it is decomposed, but is partly reproduced in the receiver. It becomes moist quickly in the air, and with water breaks up, forming hydrochloric acid, sulphuric acid, nitric oxide, &c. It also decomposes immediately in English sulphuric acid, giving off torrents of hydrochloric acid: on distillation it yields a clear colourless liquid, which is probably Williamson's compound of hydrochloric and sulphuric acids, $2SO_3+HCl$.

NOTICES OF PATENTS.

1143. *Manufacture of Iron.* J. Shortridge, Sheffield. Dated May 6, 1864. (Not proceeded with.)

The inventor dispenses with the use of the refinery and puddling furnaces ordinarily employed in the conversion of cast-iron, and substitutes a converting apparatus, which, receiving its charge from the blast furnace, effects the purification and decarbonisation of the molten iron in a continuous operation.

1136. *Sugar Boiling.* E. Beanes, Argyll Street, London, and C. W. Finzel, Bristol. Dated May 5, 1864.

In the process of boiling sugar in the vacuum pans, the inventors employ a system of hot water pipes, or low pressure steam, as the source of heat.

1145. *Puddling Furnaces.* J. H. Poole and J. Astbury, Wellington, Salop. Dated May 6, 1864. (Not proceeded with.)

In the construction of puddling furnaces for the manufacture of iron, the inventors propose to make the converting chamber in such a manner that it may be turned upon a horizontal axis while the fire is operating upon its contents. The fireplace is itself constructed in the ordinary manner.

1169. *Material to be Used for Roofing or Covering Buildings, &c.* J. F. Empson, Birmingham. Dated May 9, 1864.

The material described by the patentee consists essentially of a foundation of paper, or other fibrous material, the surfaces of which are coated with pitch or tar mixed with pounded slate or other gritty substances; or the inventor employs a mixture of pitch, tar, and asphalte, or other bituminous materials, in combination with chaff and hay, or flax and cotton waste, so as to make a plastic mass which can be moulded into sheets or slabs.

1172. *Calcining and Extracting the Oils and Gases from Ironstone and other Materials.* H. Aitken, Falkirk. Dated May 9, 1864.

The inventor treats black-band ironstone, bituminous shale, and other minerals yielding gas or oil by distillation in a special furnace, constructed with an inclined flue, which may be heated externally or not, according to circumstances. The mineral is charged into the upper end of this flue, and withdrawn, after complete calcination, at the bottom. It is recommended to mix the fuel with the powdered mineral, so that the operation may be continuous, and the gaseous or liquid products pass over, and may be collected in suitable receivers.

1192. *Manufacture of Blotting-paper.* J. Brown, Aldgate, and A. P. Price, Lincoln's Inn Fields, London. Dated May 11, 1864.

For the purpose of increasing the absorbent power of blotting-paper, the inventors impregnate the sheets with an aqueous solution of glycerin, or they incorporate a small proportion of this substance with the pulp from which the blotting-paper is to be made.

1199. *Manufacture of Aniline Dye Colours.* O. Sachs, Aldermanbury, London. A communication. Dated May 12, 1864. (Not proceeded with.)

The processes herein detailed are applicable to the manufacture of the blue and violet aniline dyes and to the purification of the same. The ingredients employed are red aniline dye, known as fuchsine, roseine, or aniline red, aniline oil, and common white soap. The last named substance is dried and reduced to powder previously to its employment. Two parts of aniline red are mixed with eight parts of aniline, and heated together until they form a thick paste, when the dried soap, in the proportion of one and a-half parts, is introduced. The mixture is maintained at a temperature varying between 210° and 220° C. for a period of time regulated according to the shade of colour to be produced; thus a red-violet will be formed in about an hour, a blue-violet in two hours, and a longer heating will produce a pure blue. The melted mass is then cooled, reduced to powder, mixed with an equal weight of benzol, and boiled off in order to separate the excess of aniline; the residual colouring matters are then washed with boiling water, dried, and dissolved for use.

In this process the fatty acids of the soap are made to perform much the same function as the benzoic and acetic acids in the other modes of manufacture, which have of late been fully discussed.

1200. *Purification of Coal Gas.* J. Phillips, Hatton, near Leeds. Dated May 12, 1864. (Not proceeded with.)

The object of this invention is twofold—viz., the purification of coal gas and the manufacture of a manure. A crude superphosphate of lime is first made by digesting ground bones with sulphuric acid, and the mixture so formed is then used for absorbing the ammonia from coal gas.

A possible disadvantage may arise from the contamination of the manure with tarry and fetid products which may restrict its application for agricultural purposes.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

3080. F. G. Mulholland, Essex Street, Strand, "Improvements in purifying rosin or other substances of a similar kind and character."

3082. R. K. Johnson, Eccleston, "Improvements in the construction of glass-makers' 'pots,' and in the application of heat to the materials or glass 'metal' contained therein."

3084. R. A. Brooman, Fleet Street, "Improvements in, or a new or improved composition for, preserving and ornamenting stone, wood, and other substances."—A communication from F. Miller, Nancy, France.—Dec. 13, 1864.

3147. H. F. McKillop, Belvedere, Kent, "Improvements in compositions for coating or covering ships."—Dec. 19, 1864.

2788. J. A. Manning, Inner Temple, "Improvements in the collection and treatment of night soil."—Petition recorded Nov. 10, 1864.

2966. J. H. Johnson, Lincoln's Inn Fields, "Improvements in the mode of, and apparatus for, stopping bottles."—A communication from H. B. Goodyear, Newhaven, Connecticut, U.S.A.—Nov. 28, 1864.

3050. A. Surflen, South Crescent, Bedford Square, "An improved washing and scrubbing compound."—Dec. 7, 1864.

3108. J. A. Pols, Nye's Wharf, Surrey Canal, Old Kent Road, "Improvements in obtaining purified or refined oils, and in obtaining oil cakes for cattle food, and foots useful for soap making."

3110. C. Hancock, West Street, Smithfield, and S. W. Silver, Bishopsgate Street, "A new manufacture of certain flexible, elastic, waterproof sheets, surfaces, compounds, and substances, and the application thereof to various purposes."—Dec. 15, 1864.

3134. R. A. Brooman, Fleet Street, London, "An improved liquid meter."—A communication from J. A. Clement, Paris.—Dec. 17, 1864.

3160. H. Bird, Berkeley Street, Cheltenham, "Improvements in treating sewage matters."—Dec. 20, 1864.

3164. H. A. de Brion, Welbeck Street, Cavendish Square, "An improved varnish for protecting and preserving metals, such as polished steel, silver plate, silver-plated and electro-plated articles from oxidation, corrosion, and from the effects of damp or the action of sulphuretted hydrogen, and improved liquid for cleaning and brightening said articles."

3170. F. Tolhausen, Boulevart Magenta, Paris, "A new and improved method of aggregating coal dust." A communication from C. Noble, New York, U.S.A. Dec. 21, 1864.

3185. J. Gillespie, Garnkirk, Lanarkshire, "The improved construction and manufacture of retorts, crucibles, glasshouse pots, and other similar vessels, and in the means and apparatus employed therein."—Dec. 22, 1864.

3195. R. A. Brooman, Fleet Street, "Improvements in coke ovens." A communication from F. J. F. Laumonier, Angers, France.—Dec. 23, 1864.

3203. B. Margulies and J. K. Leather, St. Helens, Lancashire, "Improvements in the manufacture of chromates and bichromates."

3207. E. Morewood, Cheam, Surrey, "Improvements in coating metals."—Dec. 24, 1864.

Notices to Proceed.

2063. J. Thomsen, Copenhagen, "Improvements in batteries for generating electricity, and in apparatus for converting the quantity thereof into intensity."—Aug. 19, 1864.

2150. T. Fowler, Seymour, Connecticut, U.S.A., "An improved method of coating pins and other articles with tin or other metal."—Sept. 1, 1864.

2430. W. S. Cowles, New York, U.S.A., "An improvement in means for adapting casks and analogous structures to retain petroleum, naptha, and the like fluids." A communication from L. S. Robbins, New York, aforesaid.—Oct. 3, 1864.

2937. J. White, Finchley, "Improvements in means or apparatus employed in purifying, changing the temperature, and impregnating atmospheric air, which improvements are also applicable to the purification or separation of gases or vapours, and part of which improvements is also applicable in obtaining motive power for other purposes."—Nov. 24, 1864.

CORRESPONDENCE.

Continental Science.

Paris, January 10.

A curious experiment has been made by Dr. Reichenbach, of Vienna. He believes in the existence of a cosmical powder or dust which exists all through space, and which sometimes becomes agglomerated so as to form large and small meteorites, while, at other times, it reaches the surface of our earth in the form of an impalpable powder. We know that meteorites are mainly composed of nickel, cobalt, iron, phosphorus, &c. Well, Dr. Reichenbach went to the top of a mountain which had never been touched by spade or pickaxe, and collected there some dust, which he analysed, and found it to contain nickel, and cobalt, and phosphorus, and magnesia. People have wondered where the minute quantity of phosphorus so generally distributed on the surface of the earth came from. The doctor, however, has discovered it in this mysterious invisible rain, which henceforth must be looked upon as quite as necessary for vegetation as the water which falls from the clouds. This is very pretty and poetical, but probably the discovery will not be universally believed.

No doubt, everything on this earth has its use and value, but certainly there is sometimes great difficulty in discovering it, and probably very few have ever imagined that the sting of a wasp or a bee was of any use or value, except to the animal itself or a microscopist. Now, however, we are told that a sting is a very valuable remedy, and *apisination* has a marvellous virtue in cases of marsh fever, yellow fever, headaches, nervous gastralgia, cholera, and the plague. Gasparin, we are told, cured himself of muscular rheumatism and of a bronchitis by the sting of a wasp. The remedy truly is not an agreeable one, but perhaps not much more disagreeable than a blister, and not so disagreeable as a moxa. It is rather a pity that the "*Times*' Bee-master" had not heard of this before he wrote his false and flattering notices of that busy, fussy insect, which, like other busy creatures, is continually robbed of the fruits of its labour. It is unfortunate that a bee cannot write a notice of a "Bee-master."

The lovers of tobacco have here a journal to themselves, "The Smoker," which gives details that will shock members of any anti-tobacco society. From a recent number we get the following statistics of the consumption of the weed in France during 1862. It appears that in the year mentioned there were consumed 7,261,735 kilogrammes of snuff, and 21,013,356 kilogrammes of tobacco for smoking, making a total of 28,275,091 kilogrammes, which, taking the population at 37,129,336, gives an average of 196 grammes of snuff and 566 grammes of tobacco for each individual, women and children included. Some will say that there is here quite sufficient to account for the population of France remaining stationary.

M. Payen's lecture on coal gas at the Sorbonne drew a very crowded audience, and many were sent away disappointed by not getting admission. You have so recently given your readers a full account of the manufacture of gas, that I need not detain you with any extracts from the lecture, which, indeed, contained nothing of any novelty.

The scientific literature of France is so much read in England that some of your readers may be glad to hear that a second edition of M. Bequerel's work "On Electro-Chemistry" has just been issued. In this work all the valuable discoveries of late years have been brought together, and the various practical applications of the art are fully described. The book forms the most complete treatise on the subject that has ever issued from the press.

Father Secchi sends from Rome an interesting account of some lightning conductors which have been erected under his directions. The rev. gentleman prefers to adopt the old system of carrying the rods down into a pit filled with charcoal, and not into a reservoir of water—unless, indeed, this is very large. From the extremity of the rod he distributes a copper wire about the charcoal to carry off the discharge.

The Acclimatisation Society here still continue to make great exertions to carry out their objects. Recently, a quantity of silkworms' eggs have arrived from Japan, which are now in course of distribution to the provinces. *Apropos* to this, M. Quatrefages has lately made the announcement that ungrafted mulberry-trees yield the leaves best suited for the nutrition of silkworms.

The cultivation of China grass is succeeding both in Belgium and France, and the acclimatisation of the plant seems to offer no serious difficulties. Men write as though it was expected soon to supersede flax, and even render cotton unnecessary.

M. Roudanovsky has lately made some interesting discoveries on the structure of nerves. He cuts very thin slices after subjecting the nerves to congelation, and with these he has been enabled to determine that the primitive elements of nerves are tubes having a pentagonal or hexagonal configuration. The walls of these tubes are formed of a conjunctive tissue, which in a bundle forms a true reticulum. As to the constitution, he says that every nerve has a substratum of brain matter, and also of the spinal marrow, and probably of the ganglionic matter also. The grey matter, he says, is the fundamental nervous substance, and plays the principal part in the functions. Energetic poisons, like strychnia and nicotine, affect the nervous cellules, while other poisons, such as opium, chloroform, and perhaps alcohol, modify the myeline.

Japanese Matches.

To the Editor of the Chemical News.

Sir,—The curious little Japanese firework, or one closely allied to it, has been long known to me. I saw it, when a boy, exhibited by an Italian juggler under the name of "Garofanetti," or "Pinks," alluding to the starry flower-like coruscations produced by it. The sorcerer was of course reticent as to the formula, but I set to work and finally succeeded in finding it out. It is a form of the beautiful and very curious spur fire of the Chinese,—so curious as to be worth scientific investigation.

I enclose specimens, and here follows formula:—Lampblack 5, sulphur 11, gunpowder from 26 to 30 parts, this last proportion variable with the quality of the powder. Grind very fine, and make the material into a paste with alcohol. Form it into dice, with a knife or spatula, about a quarter of an inch square. Let them dry rather gradually, as on a warm mantelpiece, not too near a fire. When dry, fix one of the little squares in a small cleft made at the end of a lavender stalk, or, what is better, the solid, straw-like material of which housemaids' carpet brooms are made (panicular stems of Arundo donax). Light the material at a candle; hold the stem downwards, and await the result. After the first blazing off a ball of molten lava will form, from which the curious coruscations will soon appear. I am, &c.

R. Trevor Clarke.

[The specimens sent by our correspondent give coruscations of extraordinary beauty.—Ed. *C. N.*]

MISCELLANEOUS.

Wurtz's Lectures on Chemical Philosophy.—As the publication of these lectures in the *Moniteur Scientifique* is very irregular, we have obtained permission (most readily conceded) to translate from the author's volume "Lecons de Philosophie Chimique." Our readers, we are sure, will unite with us in thanking the eminent author for the permission so liberally accorded. We shall commence the publication of the translation immediately.

"Science Gossip."—We have much pleasure in welcoming this new candidate for public favour. The first number contains an excellent selection of articles on different branches of natural history, and a variety of extracted paragraphs giving information of much interest to naturalists. We believe the work will have much value for the young, and, indeed, all grown people whose hobby lies in the cultivation of natural history.

Royal Institution.—The following are the arrangements for the ensuing week:—Tuesday and Thursday, January 17 and 19, at 3 o'clock, Professor Tyndall, "On Electricity." Friday, January 20, at 8 o'clock, Professor Tyndall, "On Combustion by Invisible Rays." Saturday, January 21, at 3 o'clock, Professor Marshall, "On the Nervous System."

ANSWERS TO CORRESPONDENTS.

Vol. X. of the Chemical News, containing a copious Index, is now ready, price 10s. 8d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. XI. commenced on January 6, 1865, and will be complete in 26 numbers.

B. B.—Copies are to be bought at the Patent Office, Chancery Lane, and there is a register there which you can consult.

Studiosus.—1. See the announcement on this page. 2. We have papers of the kind in contemplation.

G. F.—The arrangements of the formulæ are altogether fanciful.

A Reader should go steadily through some elementary work.

T. Ludwig.—Received with thanks. Two Numbers have been sent; the others shall be forwarded as soon as possible.

A Regular Subscriber.—Gessner's Practical Treatise on Coal, Petroleum, and other Distilled Oils, published by H. Baillière, Regent Street, London.

I.—It cannot be precipitated, but may be dissolved out and separated by sulphide of carbon.

R. Y. Z.—We can only refer you to our advertising columns for information on this subject.

Received.—X.; J. D.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Further Contributions to the Knowledge of Oxygen, by C. F. SCHONBEIN.*

In what proportion does oxygen combine with the oxidisable material in the slow oxidations which take place with the co-operation of water? The experimental answer to this question is of much importance to the theory of all slow oxidations, which so many organic and inorganic matters undergo at the ordinary temperatures and in the presence of water. My former experiments have shown that in the course of these water is always oxidised—that is, peroxide of hydrogen is formed. The fact that, under favourable circumstances, an ozonide and antozonide are reciprocally deoxidised to furnish in equivalent proportions $\oplus$ and $\ominus$ which unite to form the O becoming free—as, for instance, in the case of $HO+\oplus,MnO+\ominus$ and SO_3, which give $HO,MnOSO_3$ and 2O—has long induced me to suppose that by a similar process, which I call the "chemical polarisation of oxygen," the neutral oxygen in the course of slow oxidation of phosphorus, many metals, pyrogallic acid, and other organic substances, divides into $\oplus$ and $\ominus$, the $\oplus$ combining with HO to form peroxide of hydrogen, and the $\ominus$ with the phosphorus, metals, &c., to form phosphoric acid and oxides. It follows from the accuracy of this assumption, that on shaking lead amalgam and oxygen with water containing SO_3, an equivalent of peroxide of hydrogen and sulphate of lead will be formed. The amounts of these are easily determined if we employ a definite quantity of water with a known proportion of sulphuric acid. The uncombined acid can be estimated by means of a standard potash solution, and oxygen combined with the lead inferred from the amount of sulphate. The peroxide of hydrogen can be easily determined by means of a standard solution of permanganate of potash, $KO,Mn_2O_2\ominus_5$ corresponding to $5HO\oplus$. In this way, however, the full proportion of the peroxide can never be obtained, since it is easily decomposed by many metals, lead among them, and a part is always destroyed in the shaking with the amalgam. The amount destroyed is also sensibly influenced by the duration of the shaking, but more especially by the proportion of lead in the amalgam.

In a general way it may be stated, that the longer the shaking is continued, and the richer the amalgam in lead, the less peroxide will be found in proportion to the sulphate of lead. Under otherwise similar conditions we get by little shaking a larger proportion of HO_2, but in every case less than the equivalent for the sulphate of lead.

Among all the slow oxidations in which HO_2 is formed, the one here described appeared to me the best fitted to give a practical answer to the question stated above, and it is therefore the only one I have employed in these experiments, which seem to show beyond doubt, that in the slow oxidation of lead the oxygen is halved, and as much is taken up by the metal as by the water.

After many experiments I have found that the best amalgam to employ, in order to get the largest proportion of HO_2, is composed of 200 parts of mercury to one part of lead. Rich amalgams, as we have said, give too little of the peroxide. One containing 5 per cent. of lead, for example, gives only half the amount which is found when an amalgam containing only 0·5 per cent. is employed. The water I used contained $\frac{1}{500}$th SO_3HO. 100 grammes of this was shaken with 200 grammes of the amalgam and pure oxygen in a flask holding two litres. 300 grammes of the acidulated water were successively treated by shaking with the oxygen and amalgam for an equal length of time. After the sulphate of lead had been separated by filtration, the free acid was determined in 100 grammes by saturating with a dilute solution of potash of such a strength that one gramme should neutralise one milligramme of monohydrated sulphuric acid. As 100 grammes of the acidulated water originally contained 200 milligrammes of SO_3HO, 200 grammes of the potash solution should be required for their saturation. But if only 151 grammes are necessary, the remaining 49 correspond to the same number of milligrammes of SO_3HO which have combined with oxide of lead; hence it follows that during the shaking 193·7 milligrammes of lead have united with 8 milligrammes of oxygen.

Another 100 grammes of the liquid was employed for the determination of the peroxide of hydrogen. For this I made use of a solution of permanganate of potash so titrated that one grm. contained one mmgr of $\ominus$, and, therefore, would be decolorised by one mmgr. of $\oplus$; or, which is equally the same thing, 8 grms. of the coloured solution of permanganate corresponded to 17 mmgrs. of peroxide of hydrogen †. Now if 100 grms. of the shaken acidulated liquid completely decolorises 8 grms. of the permanganate solution, we must conclude that that liquid contains 17 mmgrs. of peroxide of hydrogen, or 8 mmgr. of $\oplus$, and, consequently, that equal quantities of oxygen have united with the lead and with the water. It has been already remarked that the proportion of sulphate of lead to peroxide of hydrogen differs according to the duration of the shaking of the lead amalgam with the acidulated water, and that the longer the shaking is continued the greater becomes the excess of lead salt. To procure the largest proportion of peroxide, the shaking should not last longer than is necessary to form enough $PbOSO_3$ and HO_2 to estimate accurately. In a number of experiments in which the shaking lasted ten seconds the proportion of oxygen combined with the lead compared with that combined with the water was as 100:95; in single instances, indeed, it was as 100 : 98. But if the shaking is continued until the acidulated water but slightly reddens litmus paper, a perceptible quantity of HO_2 will be found in the liquid, yet obviously very little in proportion to the sulphate of lead formed at the same time. And if the agitation be prolonged until the whole of the acid is neutralised, scarcely a trace of peroxide will be found in the water, so quickly is it destroyed by the amalgam when not under the protecting influence of the sulphuric acid.

It would appear impossible to obtain a full equivalent of peroxide of hydrogen for the sulphate of lead formed, but we have seen that in the experiment in which the shaking lasted ten seconds the amount came sensibly near to the theoretical quantity. If it were possible to determine the amount of sulphuric acid which becomes combined, and the amount of peroxide which is formed in the first seconds of the shaking, no doubt complete equivalents would be formed. It must be granted, then, that in the oxidation of the lead the oxygen divides itself equally between the metal and the water, and we are entitled to conclude that such a halving of oxygen

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* Abridged from the *Jour. für Prakt. Chemie*, bl. xciii., p. 24.

† Such a solution is made by dissolving 1·852 grms. of pure permanganate (containing 0·40 grms. of $\ominus$) in 398·418 grms of water.

takes place during all other slow oxidations caused by the presence of water. But there must always be accessory circumstances depending upon the easy decomposibility of the peroxide of hydrogen, which prevent us from recognising this halving. If, for example, we are unable to detect peroxide of hydrogen in the blood, it does not follow that none is formed; for we know that the blood corpuscles possess in an eminent degree the power of destroying HO_2, which power they must obviously exercise upon the peroxide formed during respiration.

The influence exercised by some accessory circumstances will be seen from the following result:—In the mixture shaken for thirty seconds the proportion of oxygen combined with the lead was to that united with the water as 100 : 69. Some coal-dust added to the mixture before shaking reduced the proportion to 100 : 29; and more coal-dust shaken with the filtered liquor removed all trace of HO_2. There can be no doubt that HO_2 is formed in the presence as well as the absence of coal; but by the decomposing action of the coal it is changed into water and ordinary oxygen. Spongy platinum having a still stronger decomposing action, it may be supposed that the presence of a small amount of that body would entirely prevent the discovery of HO_2.

The following is another example of the same kind:—Peroxide of hydrogen is formed when an alkaline solution of pyrogallic acid is shaken with oxygen or atmospheric air, and can be detected by supersaturating the liquid with SO_3, and shaking it with an equal bulk of ether and a few drops of solution of chromic acid. The presence of peroxide is shown by the strong blue colour communicated to the ether. But if the potash solution is coloured decidedly red by defibrinated blood, we obtain under similar circumstances, a solution in which no HO_2 can be detected, though there can be no doubt that the pyrogallic acid is oxidised as well in the presence as the absence of blood corpuscles, and HO_2 formed under both circumstances. As I have observed that the albumen of the defibrinated blood does not act catalytically on HO_2, it must be the blood corpuscles which induce the destruction.

Lately I have observed that there are many bodies in the animal and vegetable kingdoms which like platinum, coal, and blood corpuscles have the power of destroying HO_2. No peroxide is found in the blood after respiration, nor is it shown in the slow oxidation of organic matters in damp air, but it does not follow that none has been formed.

The foregoing I believe support my often repeated opinion that oxygen may exist in two oppositely active and in one neutral condition, and that these conditions may be changed one into the other. I have not yet ventured to express any supposition of the proximate causes for these conditions and their changes, but this much appears certain, that they play an important part in all oxidations which take place with ordinary oxygen and at common temperatures. The most important of these are the decompositions of organic matter, and the respiration of animals, in comparison with which all other oxidations which take place on the earth are insignificant.

Before we knew the different conditions of oxygen, we were obliged to believe that this elementary body threw itself upon the oxidisable material without itself undergoing any change. But the latest facts discovered appear to justify the belief that neutral oxygen can produce no effects of oxidation without dividing into two oppositely active conditions, or, as I have elsewhere termed it, undergoing chemical polarisation; and this chemical polarisation appears to be the proximate cause of the comprehensive chemical changes which take place between atmospheric oxygen on the one hand and oxidisable materials on the other in the presence of water.

Production of Ammonia from Air and Water, under the Sole Influence of the Porosity of Arable Soil, by M. Decharme.

The author set himself to determine this question:—Is arable soil, under ordinary conditions, capable, simply by virtue of its porosity, and the influence of humidity, of transforming part of the atmospheric nitrogen which penetrates and traverses it, into ammonia or ammoniacal salts?

Direct experiments have shown this to be possible. By passing 200 litres of air (at the rate of 10 litres per hour) freed from its natural ammonia, over 250 grammes of ordinary vegetable earth, previously washed, or calcined and washed, or estimated relatively as to its total of nitrogen, then restored to its usual state of humidity, and raised progressively from the temperature of 10° to about 52°, M. Decharme found that part of the nitrogen of this air had been transformed into ammonia, into carbonate and nitrate of ammonia.

The total amount of ammonia thus produced by the catalytic force of the earth experimented upon was at an average of 0·139 gr., a small absolute quantity no doubt, but in reality considerable if we compare the atmospheric ammonia to that of rain water.

This result corroborates and completes the explanation of several facts of importance in a physiological and agricultural point of view—among others, the good effect of airy drainage and ploughing, the improvement of land by fallowing, the formation of nitrates in the soil, cultivation without manure, the presence of nitrogen in plants growing in an artificial soil, deprived of nitrogenised matters removed from atmospheric air, and watered with pure water.

It also shows how all natural causes (winds, rains, changes of temperature and of pressure, &c.), or artificial causes (fallowing, drainage, &c.) which determine the introduction and movement of air in the soil, favour the production of ammonia, and contribute to the development of vegetation, a view perfectly in accordance with the facts observed in practical agriculture.—*Les Mondes.*

TECHNICAL CHEMISTRY.

Contribution on the Manufacture and Refining of Cane Sugar, by Ch. A. Goessmann, *Ph.D., Syracuse, New York.*

Mr. Kessler has lately communicated, in a letter to Charles Barreswil,* observations concerning the application of caustic magnesia for the defecation of the raw juice of the beet. The results obtained proved so very satisfactory that he is in favour of the use of caustic magnesia instead of caustic lime, which at present is almost universally applied for that purpose. As these statements cannot fail to attract the attention of the manufacturers of raw sugar, as well as of sugar refiners, I have thought that a further publication of observations of the same or similar import would prove acceptable to the parties interested.

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* *Repert de Chim. Appliquée,* by Mr. Charles Barreswil. Paris, July 7, 1863. P. 251.

The fresh juice of the real sugar cane, obtained by pressure of powerful iron rollers, contains in solution sufficient of such nitrogenous matters as would produce, not only a rapid transformation of the entire amount of cane sugar into grape sugar (glucose), but also the subsequent destruction of the latter by fermentation. The tropical climate of the countries where the sugar cane is most successfully raised tends in a high degree to these disastrous results. Any means, therefore, which would effectually, and at the same time most rapidly, deprive these compounds of their obnoxious influence should in these localities deserve particular attention in preference to all others. Their removal by coagulation and precipitation, and not their destruction while still in their original solution, has been, for obvious reasons, the main aim of a successful defecation. Several acids, various basic oxides, and some of their compounds, have been known for a long time to precipitate more or less thoroughly a series of indifferent organic compounds similar to those which accompany the cane sugar in the cane juice, and quite a number of them have been actually recommended at different times for the manufacturing of the sugar more advantageously. Some oxides and their soluble compounds, probably best adapted to the producing of this effect, have been rejected on account of the danger arising from a possibility of neglect in removing poisonous compounds.† Baryta, it seems, has suffered the same fate for the same reason.‡ Caustic lime, which meets everywhere with favour, has retained its reputation thus far, probably not less on account of its superior action than on account of its cheapness and the harmlessness of its compounds. While a general preference has thus been conceded to the latter, there were always some reasons why the manufacturer of sugar felt disposed to listen to new propositions and try new experiments which might obviate the inconveniences arising from the use of caustic lime, or to substitute in its stead some compound more liable to expense, it is true, but more open to beneficial results. The steadily increasing price of bone black is one of the main causes which urges manufacturers and refiners to improve their methods, and to lend a more willing ear to new suggestions.

The more costly caustic magnesia, if proved efficient, might, even on that account, expect at present a fairer chance of introduction than it would have claimed at an earlier period in the development of the manufacturing, as well as the refining, of sugar.

Caustic lime is highly soluble in a solution of cane sugar—a peculiarity which may be the real source of the objections sometimes raised against its application for the defecation. I favour the opinion that the main disadvantages which may result from its use are due less to its inefficiency, compared with other means hitherto proposed for that purpose, than to the variable character of cane juice itself; for the kind of cane, season, soil, &c., mark their influence upon the latter, not to speak of the unreliable quality of caustic lime rather too commonly employed. In taking this view of the question, I believe I by no means deny or underrate the fact that those circumstances which cause the changeableness of the cane juice, &c., have been the source of many vexations, and that they require, in order to be successfully counteracted, the most careful attention on the part of a well-informed superintendent.

Considering the waste of cane sugar, in consequence of an inefficient removal of the ferment-creating compounds of the cane juice, the most serious feature in the manufacture of sugar within the tropical climes, I cannot but believe the unavoidable darker colour, which even a careful application of caustic lime necessarily produces, the less of the two evils dreaded. Speaking of an unavoidable darker colour as a natural consequence of the use of caustic lime, it seems advisable to explain my meaning of that statement, Caustic lime, although considered a very efficient means of rendering most of the obnoxious compounds of the cane juice insoluble near or at the boiling point, does not remove them entirely at that temperature, as experience plainly shows. Such an effect requires a continued boiling of the slightly alkaline liquid. The usual manner in which the defecation of the cane juice is carried on absolutely excludes, as we are aware, such a proceeding; and as heat alone does not destroy rapidly enough the fermenting compounds, a certain degree of an alkaline reaction in the defecated juice must prove to be the best protection of the cane sugar, since it secures the subsequent destruction of the compounds in question. While thus a slight excess of caustic lime secures a good result as regards the quantity of cane sugar finally obtainable, it causes, on account of that desirable effect, quite a considerable increase of colour in the cane juice and in the syrups during the process of the manufacture. The danger of neglect in the use of different methods merits serious attention when commenting on the means to be taken in order to have satisfactory results. However, this danger ought not to influence too exclusively the final conclusion as to the means, since, to make a fair comparison between them, we must suppose equal care in the execution of the processes. To ascertain the proper quantity of lime necessary to procure an increased percentage of cane sugar as a compensation for the pecuniary disadvantages, resulting from a darker colour in the clarified juice, will doubtless be considered a much easier task by sugar masters in the tropical climates than to obtain a satisfactory percentage of the better qualities of raw sugar from an imperfectly defecated cane juice.

Before I had witnessed § the rapidity and the extent of the decomposition of cane sugar during the manufacture of the raw sugar, I felt somewhat inclined to believe that the good results which I had observed in many instances in the refining of the latter by the application of caustic magnesia might find a further illustration in the defecation of cane juice.

Yet my own personal observations while in Cuba have altered my opinion, and I am now strongly inclined to believe that the "exclusive" use of caustic magnesia in the warmer climate for defecation would be both an expensive and dangerous experiment, at least so long as the present system of manufacturing is adhered to in its main features. In regard to countries of a more moderate clime, I do not assume to express any opinion, for my experience does not entitle me to question any of the results reported by Mr. Kessler. My doubts of the efficacy of caustic magnesia for the purpose above mentioned in said localities are also strengthened by the results of a series of experiments which I made several years ago.‖ Those experiments were made partly for the purpose of confirming my views with respect to certain statements in our chemical literature, partly also

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† Liebig and Kopp's *Jahresbericht*, 1847-48, p. 1106; and 1849, p. 704; and 1850, p. 68. Patent Office Report, 1849-50, p. 463.

‡ Leplay and Dubrunfaut, Liebig and Kopp's *Jahresbericht*, 1863, p. 751. *Repert. de Chim. Appliquée*, ii., p. 169.

§ Those observations date from the winter of 1860 to 1861, while visiting the island of Cuba.

‖ These experiments were made in 1857, when I was engaged in studying the efficacy of caustic magnesia for refining purposes.

for the purpose of comparing the effects of caustic lime and caustic magnesia under certain corresponding circumstances. I here briefly state the results, as far as they bear upon the subject in question, for the purpose of enabling parties interested to form their own opinion as to the consequences, and to supply any deficiency, if such is their wish. I proposed to myself the following questions:—

1. What influence has caustic lime upon cane sugar and upon grape sugar?

2. Does atmospheric air or pure oxygen gas influence the effect of caustic lime upon the two kinds of sugar in question?

3. Does a ferment, dissolved in a solution of cane sugar, retain its peculiar influence upon the various kinds of sugar after having been subjected to a boiling heat?

4. What influence has carbonate of lime under the circumstances stated in the previous question?

5. How does a ferment act upon cane sugar in the presence of either caustic lime or caustic magnesia?

The remarkable solubility of caustic lime in a solution of cane sugar has been the subject of a series of investigations, the result of which[¶] tend in a great part to establish the following facts:—Caustic lime, under different circumstances, forms different combinations with cane sugar. More concentrated solutions of the latter dissolve larger quantities of the former, and the combinations formed in some instances are more soluble at common temperature than at their boiling point, for heated they form, by a certain concentration while insoluble, compounds in the form of precipitates.

When engaged in repeating the former mentioned experiments, I became convinced that cane sugar is not changed by caustic lime, and that it may be separated again completely, and remain unchanged. Grape sugar, heated with caustic lime, is easily destroyed, and forms, according to temperature, more or less of a resin, like hemin, a substance composed of carbonic acid and of formylic acid.[**]

Access of air does not alter materially in either case the effects mentioned, for cane sugar does not suffer at all, and grape sugar seems only to produce the volatile acids in a larger proportion. The effects of pure oxygen gas upon both kinds of sugar in the presence of a basic oxide—for instance, caustic lime (or caustic baryta)—differ much in intensity. The experiments which elicited this fact were thus made:—At common temperature, and over mercury, I filled two long-necked glass flasks, one partly with a solution of grape sugar, the other partly with a solution of cane sugar (both solutions containing an equal amount of caustic baryta dissolved), and partly with oxygen gas. The solutions rested in both cases upon a broad sheet of mercury. I substituted caustic baryta for caustic lime for this reason, that it would enable me to produce, as far as possible in both cases, colourless solutions with an equal percentage of the basic oxide. The solution of cane sugar remained for weeks almost unchanged. The corresponding solution of grape sugar absorbed rapidly the oxygen gas, with hardly any change in colour. The absorption in either case was favoured by a repeated shaking, and took place at common temperature. The final results in the latter case consisted of a slightly yellowish solution, which contained formylate of baryta and an excess of caustic baryta, while some carbonate of baryta was separated. It required a considerable time to destroy the last trace of colour. V. G. Besanez[††] has lately published some interesting observations on the effect of ozone upon various organic compounds. He obtained with grape sugar such results as I myself obtained with oxygen gas. The quantity of oxygen gas originally brought in contact with the solution in question was repeatedly renewed, and in every case almost entirely absorbed. Whether this contained ozone, and in what quantity, I cannot state, for I made no test for the purpose of ascertaining it.

(To be continued.)

PHARMACY, TOXICOLOGY, &c.

Bismuthi et Ammoniæ Citras, by N. Gray Bartlett.[*]

A PREPARATION, under the somewhat empirical name of "Liquor Bismuthi (Schacht)," was introduced to the profession, some years since, in England, and more recently it has been the subject of several notices in foreign medical publications.

This liquid contains a bismuthic salt in permanent solution, and is miscible with water without precipitation. Its reaction is alkaline, and it possesses but little taste. These desirable properties in a remedy usually administered in a comparatively insoluble condition would seem to indicate that this solution had not received undue attention.

It is asserted by the originator, M. Schacht, apparently after abundant observation, that a fluid drachm of his preparation, containing one grain of teroxide of bismuth, is equivalent in medicinal value to a full dose of the subnitrate of bismuth.

The liquor bismuthi was subjected to analysis by Mr. Tichbourne, who found its constituents to be bismuth, citric acid, and ammonia. (*Lond. Pharm. Journ.*, Jan. 1, 1864.)

Following the directions of that gentleman for its preparation, recently precipitated teroxide of bismuth was boiled in a solution of citrate of ammonia. Repeated trials proved the oxide to be but sparingly dissolved by this treatment, and demonstrated the impracticability of this process. The alternative method suggested—that of substituting citrate of bismuth for the oxide—yielded a more satisfactory product.

The writer, having observed the solution of citrate of bismuth, obtained by the addition of ammonia, to have an acid reaction, and also that an excess of that alkali occasioned a precipitate of oxide of bismuth, inferred the existence of a compound salt of bismuth and ammonia. This was subsequently confirmed.

The following formulæ, suggested by theory and numerous experiments, were finally adopted:—

Bismuthi Citras.—Take of subcarbonate of bismuth a troy ounce; citrate of potassa a troy ounce and 120 grains; nitric acid a troy ounce and a half; distilled water a sufficient quantity. Dissolve the subcarbonate of bismuth in the nitric acid, and, when effervescence has ceased, dilute the solution with a fluid ounce and a half of distilled water, gradually added. Dissolve the citrate of potassa in two pints of distilled water, and to this liquid add slowly, with constant stirring, the acid solution of bismuth.

Permit the mixture to stand for several hours; then pour it on a moistened paper filter, and when the liquid

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[¶] *Comptes Rendus*, xxxii., pp. 333-469. Peligot, Subeiran, Pelouze, &c.

[**] Compare Chevalier and Cottereau, Peligot, &c.; Berzelius' *Jahresbericht* for 1846.

[††] *Annalen der Chem. a Pharm.*, Wöhler, Liebig, and Kopp. 1865. No. for February, p. 211.

[*] *American Journal of Pharmacy.* January, 1865.

has nearly ceased to pass, cover the surface of the precipitate with distilled water.

Repeat this operation until the washings no longer contain nitric acid. Allow the magma to drain, and dry it on bibulous paper with a gentle heat.

Bismuthi et Ammoniæ Citras.—Take of citrate of bismuth, in powder, a convenient quantity; stronger water of ammonia, distilled water, each a sufficient quantity. Rub the citrate of bismuth with sufficient distilled water to reduce it to a uniform pasty consistence, and add cautiously, with constant trituration, stronger water of ammonia until a solution is obtained, observing to avoid an excess of ammonia.

Filter the liquid through paper, returning the first portions that pass, should they be turbid.

Spread the clear solution on glass, that the salt may dry in scales.

Liquor Bismuthi et Ammoniæ Citratis.—Take of citrate of bismuth and ammonia 260 grains; alcohol, two fluid ounces; distilled water, fourteen fluid ounces; water of ammonia, a sufficient quantity. Dissolve the citrate of bismuth and ammonia in the distilled water, neutralise the liquid with water of ammonia, and mix it with the alcohol.

Or, take of citrate of bismuth, recently precipitated, and still moist, a convenient quantity; water of ammonia, alcohol, distilled water, each a sufficient quantity. Add gradually to the citrate of bismuth water of ammonia, until the precipitate is dissolved, and a neutral solution is obtained. Dilute this with its volume of distilled water, and filter through paper, returning the first portions of the filtrate, if necessary, until the liquid passes clear.

To half a fluid ounce of this solution add hydrosulphate of ammonia in slight excess. Pour the mixture on a tared paper filter, wash the precipitate thoroughly with distilled water, and dry it at a temperature of 212°. Weigh the filter and its contents, deducting the weight of the former to obtain that of the tersulphide of bismuth, which, in grains, is to form a third term in a rule-of-three proportion, thus:—

$$\begin{array}{cc} (BiS_3) & (BiO_3) \\ 261: & 237:: \end{array}$$

the weight of tersulphide of bismuth to that of teroxide of bismuth in half a fluid ounce of the solution.

Apply the same ratio to the remainder of the liquid, and dilute it to such an extent that a grain of teroxide of bismuth will be contained in each fluid drachm of the finished solution; seven-eighths of which measure must be made up with distilled water, and the remainder with alcohol.

For preparing the citrate of bismuth, the subcarbonate is preferable to the subnitrate, because of its more uniform composition, as well as its greater purity, at least in commercial specimens of these salts. The metal itself is inferior to either, as it is almost invariably contaminated with arsenic.

The bismuth and potassa salts are employed in nearly atomic proportions for the production of a neutral citrate of bismuth; the potassa salt, however, is in slight excess, on account of its deliquescent nature. By using solutions considerably diluted, the precipitate is rendered less dense, and the washing, by displacement, is thereby facilitated. This is a tedious part of the process, but the best means of accomplishing the purpose. Washing by decantation is inapplicable, for, before it has been carried to a sufficient extent, a portion of the powder will remain suspended in the liquid, and can only be separated by boiling.

It also entails a greater loss of the citrate of bismuth, which is slightly soluble in water. The absence of nitric acid from the washings can be judged of approximately by the taste, but better by faintly tinging a portion of the liquid with sulphate of indigo, and boiling in a test-tube for a few minutes; if the colour be retained, no nitric acid is present.

In the preparation of citrate of bismuth and ammonia, the citrate of bismuth previously dried is employed, in order that a concentrated solution may be obtained without resort to evaporation, as the heat necessary in this operation occasions a precipitate, caused, apparently, by a loss of ammonia.

The solution should be spread with a brush, on panes of glass, to dry.

Citrate of bismuth and ammonia, as thus prepared, is in the form of brilliant, white, semi-translucent scales, not at all deliquescent, but readily soluble in distilled water.

An aqueous solution of this salt, if long kept, like those of the citrates in general, is subject to spontaneous change. The addition of small portions of alcohol and ammonia, as indicated in the formulæ for a solution of citrate of bismuth and ammonia, will, it is believed, preserve it indefinitely. The same result could probably be secured by means of sugar, with the additional advantage of a more agreeable taste.

The composition of the compound salt, determined by direct analysis, is as follows:—

BiO_3	=	237	=	50·11	per cent.
NH_4O	=	26	=	5·50	,,
$C_{12}H_5O_{11}$	=	165	=	34·88	,,
$5HO$	=	45	=	9·51	,,
$BiO_3,NH_4O,Ci + 5HO$	=	473		100·	

The bismuth contained in the washings can be recovered by neutralising them with ammonia, and treating with sulphuretted hydrogen. The precipitated tersulphide of bismuth, after having been washed and dried, may be reduced to the metallic state, or converted into the subcarbonate by suitable means.

The writer is unable to state any facts in relation to the therapeutical properties of citrate of bismuth and ammonia. Owing to its solubility, it would undoubtedly be more perfectly diffused over the mucous surfaces, or more readily absorbed into the system, than the ordinary salts of bismuth.

Accepting the evidence of M. Schacht as conclusive, the dose of this salt would be two grains, or of the solution a fluid drachm.

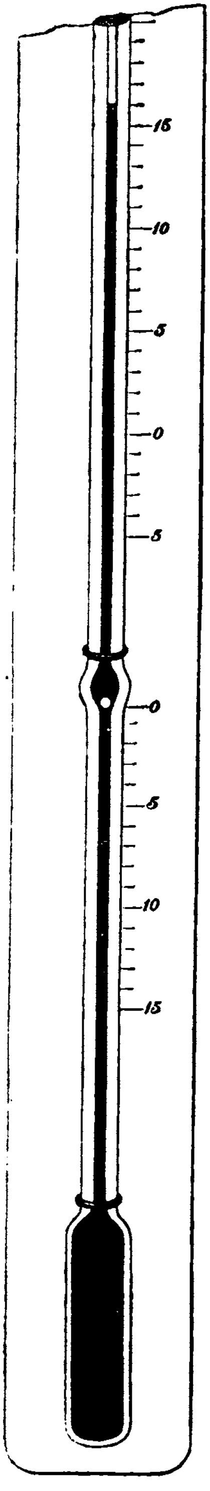
Chicago, Illinois, November, 1864.

PHYSICAL SCIENCE.

On Appliances for Taking Deep Soundings, by T. Twining, *Esq.*

In 1833 and the following years, I occupied myself with inventing appliances for taking deep soundings, and tried a variety of experiments with that view on the Lake of Thun, in Switzerland, where my apparatus used to go to the bottom and return to the surface without line. Wishing to add thermometrical as well as barometrical observations, I contrived an upright minima thermometer, and was led from that to a more useful maxima thermometer on the same principle, which is the one I described to you some time since, and of which, encouraged by your approval, I now take the liberty of forwarding to you a drawing and description.

It is a spirit thermometer, having, about one-third of the way up the tube, a small bulbous enlargement, in which is lodged a globule of mercury, which serves as an indicator. As long as the spirit rises, this globule remains stationary; but as soon as the spirit descends, it descends likewise, lengthening into a small cylinder about $\frac{1}{10}$th or $\frac{1}{12}$th of an inch long, which cuts in two the column of alcohol. It is evident that on adding to the degrees marked by the extremity of the spirit column those shown by the inferior extremity of the indicator on the lower scale, we ascertain at once the maximum of heat to which the apparatus has been exposed.



It is thus that I made a course of observations on the summer heat of the valley of Interlacken. My thermometer was suspended in a convenient place just outside the window where there would not have been room enough for an ordinary horizontal maxima. Every morning the addition of the indications on the two scales was made to obtain the maximum heat of the preceding day. The bulb of the instrument was then warmed with the hand till the mercury reached the enlargement; the instrument was laid flat whilst the spirit came down, and the thermometer was then hooked up again ready for the day's observation.

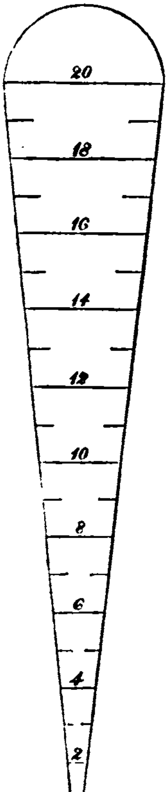
Having had suitable tubes made by a glass-blower at Paris, I had no difficulty in filling, mounting, and graduating several thermometers of the above description. The only operation which required rather more than ordinary care was the graduating of the lower scale. It was necessary to mark, one at a time, the first two degrees, on account of the widening of the tube in this part.

I at first apprehended that the globule of mercury might not always be quick enough to join the descending column of alcohol, but repeated trials convinced me that my apprehensions were not founded, and the only objection which my thermometer is open to, besides those which to some extent always attach to spirit thermometers, is this, that if a considerable time is allowed to elapse between the heur of maximum temperature and the recording of the observation, the mercury will be apt to move in a slight degree from its place, sliding gradually through the spirituous fluid. A series of special experiments in reference to this peculiarity has convinced me that it does not proceed from any preventible cause, and that from its irregularity it cannot be made allowance for; but at the same time I have found that the movement in question is so slight as not to affect the practical usefulness of the instrument for daily observations of temperature, or to counterbalance the advantages which it presents—1stly, as a means for taking observations where only an upright thermometer can be used; 2ndly, as not being affected by travelling; and 3rdly, as an appliance which almost every ingenious mechanic may make for himself at a very small expense.

By suspending this thermometer bottom upwards, it may be made to serve to a certain extent as a minima thermometer, but with this drawback, that after each observation a stronger degree of cold than that recorded must be artificially produced to bring the mercury back into its cell, which cannot always conveniently be done; whereas in the case of maxima of heat the mercury is easily put to rights by the application of the hand to the bulb, or if that should not be sufficient, by a little artificial heat.

I have mentioned that barometrical as well as thermometrical observations were connected with my sounding experiments on the Lake of Thun. The barometer which I used was one made by myself on a principle analogous to that adopted by Gay Lussac, but presenting certain advantages which I shall be happy to explain if desired. In the meantime, I beg leave to draw your attention to two little appliances which I found very useful in ascertaining whether the tubes which I required for various purposes were of equal bore, or nearly so, at both ends, as well as for insuring accuracy in the selection of the calibres required.

The larger one is a slip of brass shaped like a wedge, ten centimetres long and two centimetres across at its widest part. On introducing it, as far as it will go, into the ends of a tube, the calibre of the latter in millimetres is indicated to a nicety by the graduated scale which shows the width of the wedge in the various parts of its length. The smaller instrument, used in a similar manner for narrow tubes, is a silver cone very carefully made and graduated, and having two centi-



metres in length with a largest diameter of two millimetres.

Feryn House, Twickenham, January, 1865.

PHOTOGRAPHY.

Chloride of Iron, by M. Jean Obernetter.

Having remarked the property possessed by chloride of iron of converting finely powdered silver into chloride of silver, and of redissolving this compound after its formation, M. Obernetter proposes to employ it in the following ways:—

1. To remove stains of silver from the hands, clothes, &c., it is only necessary to apply the solution to the spot with a brush or pencil, and then to wash it. Chloride of iron is not injurious to the skin, and is preferable to cyanide of potassium, which is so dangerous.

2. To reduce to a proper degree a too black negative plate, pour, after fixing the proof, a greatly diluted solution of chloride of iron on its surface, and when the desired depth has been produced wash it well. By this means the most delicate details remain uninjured.

3. To make faint negatives deeper, run a weak solution of chloride of iron over the glass plate; then strengthen with pyrogallic acid and silver mixed.

The operation should be performed in diffused light, in order to facilitate the reduction of the chloride of silver. This method is especially adapted for obtaining instantaneous proofs.—*Bulletin de la Société Chimique*, 399, 64.

PROCEEDINGS OF SOCIETIES.

PHARMACEUTICAL MEETING.

Wednesday, January 4.

Mr. Sandford, *President, in the Chair.*

(*Continued from page* 19.)

Dr. Attfield's paper was entitled "*Notes on the Chlorides of Iron, and the Methods of Making Solution of Perchloride of Iron of Constant Strength.*" The following is a short abstract of the paper. Theoretically—and practically also, when a pure solid compound is required—the simplest way of forming a chloride of iron is to bring together the two elements. This may be done on the small scale by passing dry chlorine into a flask about a third filled with iron nails, and kept at nearly a red heat. Under these circumstances protochloride is formed when iron is in excess, and perchloride when chlorine predominates. The latter sublimes at a lower temperature than the former, and will be found adhering to the upper part of the flask in the form of dark green iridescent scales. If the operation be stopped before the whole of the nails have been acted upon, the residual iron will be found compacted together by small micaceous crystals of the protochloride. Anhydrous perchloride of iron rapidly absorbs moisture, but once dissolved in water it gives a liquid which will probably remain unimpaired for any length of time, unless heated, when it decomposes and hydrochloric acid is evolved—a fact which should be remembered by the analyst and the pharmaceutist. Sometimes the oxide precipitated dissolves as the solution cools, but this is only when much perchloride remains undecomposed, and depends upon the solubility of the oxide in a solution of the chloride. Perchloride of iron is also soluble in ether and alcohol, but these solutions are unstable; they soon become opalescent, and basic chloride is deposited. Heat in both cases accelerates this decomposition. Under the continued influence of light another reaction occurs with these solutions; the perchloride of iron becomes reduced to protochloride, and the chlorine set free combines with the carbon and hydrogen from the ether or alcohol to form probably chlorides of ethyl and ethylene, and chlorinated derivatives of those bodies. It would seem that this reaction soon occurs, for solutions of the perchloride in alcohol or ether soon acquire the odour of the bodies alluded to. Protochloride of iron dissolves in water, alcohol, and ether, but forms unstable solutions. An aqueous solution decomposes when boiled, and moreover the protochloride volatilises to a considerable extent with the water. A semi-spirituous solution of the neutral perchloride, such as the tincture of British Pharmacopœia, is very unstable, but the addition of a few drops of hydrochloric acid to each ounce will prevent decomposition. Another method of making perchloride of chlorine is first to prepare a solution of the protochloride by dissolving iron in hydrochloric acid, and then passing chlorine into the solution. To make a solution of the officinal strength, two ounces of fine iron wire must be placed in a mixture of six and a-half fluid ounces of hydrochloric acid (sp. gr. 1·17), and three and a-half ounces of water. When the iron is dissolved the carbonaceous residue must be separated and chlorine passed into the solution until it gives no precipitate with ferridcyanide of potassium. The excess of chlorine must be got rid of by boiling, in which operation much hydrochloric acid is lost, and the solution consequently becomes very basic. The third process noticed was that of the British Pharmacopœia. Iron is dissolved in hydrochloric acid, and nitric acid is added to the solution. In this process the hydrogen of the uncombined acid is oxidised, and the chlorine set free unites with the proto- to form perchloride of iron, binoxide of nitrogen escaping. The whole reaction may be thus expressed,—

$$6Fe + 9HCl + NO_5 = 3Fe_2Cl_3 + 3HO + NO_2.$$

This process is open to numerous objections, and only by chance yields a pure product, that is, a neutral solution of the perchloride. If an exact proportion of real hydrochloric acid be employed, the solution decomposes in the boiling necessary to get rid of the black compound with binoxide of nitrogen, but when more hydrochloric acid than is necessary for the reaction is used, the solution, excepting the presence of the hydrochloric acid, is all that can be wished. Dr. Attfield next discussed the British Pharmacopœia process for "*Liquor Ferri Perchloridi.*" When this process is strictly followed the solution contains pernitrate of iron, and is deficient in hydrochloric lost during evaporation. By using the theoretical quantity of nitric acid, four fluid drachms eighteen minims (according to Ure's table) and a little more hydrochloric acid than the Pharmacopœia directs, the Doctor has succeeded in forming a solution of the officinal strength which contains no nitric, but of course an excess of hydrochloric acid, and which gives with spirit a solution which may or may not be stable. The fourth process referred to was preparing a solution of perchloride by dissolving peroxide in hydrochloric acid. This process, which looks so simple, is perhaps the most uncertain and complicated of all. It involves the preparation of a pure peroxide, which is not easy to procure. Dr. Attfield recommends pharmaceutists never to employ this method in making the tincture of the sesquichloride. In conclusion, he recapitulated the chief points of the paper, and stated that the only method of producing a pure solution of perchloride of iron of officinal strength is to dissolve the anhydrous perchloride in water; such a solution is stable in the cold, and can be prepared of definite strength. Finally, he condemned the use of the so-called tincture, which, however, he admitted, was not liable to decomposition when a slight excess of acid was present.

The discussion on this paper was deferred until the next meeting.

ACADEMY OF SCIENCES.

January 9, 1865.

It may be noted, as an unusual circumstance, that no chemical paper was read at this meeting. One or two papers of considerable interest on other branches of physical science were, however, communicated. One of these was by M. Carlier, "*On a New System of Electro-Magnets with Uncovered Wire.*" An electro-magnet consists essentially of an iron cylinder covered with a helix of metallic wire, through which passes a current of electricity. Until now it has been supposed necessary to insulate the wire composing the helix by covering it with silk, cotton, gutta-percha, or some other insulator. M. Carlier, however, finds that the covering is not only unnecessary, but disadvantageous. By using an uncovered wire, but separating the layers of spirals one from the other by paper envelopes, the magnetic effects are twice as strong as when a covered wire is employed.

M. l'Abbé Laborde described "*An Apparatus for Simplifying Spectrum Analysis.*" With this apparatus he is enabled to observe the spectra of metals with a small induction coil and a pocket spectroscope, and to compare the spectra of two metals at one time. The description of the apparatus is almost unintelligible in the absence of illustrative cuts, but one remark which the author makes must be quoted. He says that the colour of the bands is a very uncertain means of recognising a metal, and it is far more certain to determine the position of those first seen. He notes in every metal bands of different visibilities, just as in a constellation stars of different sizes are seen. We shall probably return to this paper.

M. Tellier made a communication "*On the Use of Ammoniacal Gas as a Motive Force;*" he gave, however, only the crude idea, without details of the machinery he intended to employ in drawing an omnibus through the streets with two ammoniacal horses. Ten kilogrammes of liquified ammonia, he states, will do the work of one horse for an hour.

NOTICES OF BOOKS.

Zeitschrift für Chemie und Pharmacie. Nos. 22, 23. 1864.

Most of the papers which appear in these two numbers of this journal have already been noticed in connection with other journals, or have appeared at length in the Chemical News. In No. 23, however, we find a *Method of preparing sodium amalgam*, which may be useful to some of our readers. The author, Dr. Mulhauser, fuses sodium in a deep dish under naphtha, and adds the mercury gradually in a fine stream, which occasions a slight hissing, and inflames the naphtha. The sodium swells up, and forms at last a solid mass, which may be allowed to cool under the naphtha. In this way a pure product of definite composition may be procured without loss.

Werigo communicates a second "*Preliminary Notice on the Action of Sodium Amalgam on the Homologues of Nitrotoluol.*" With nitrotoluol he obtained a red crystalline body, *azotoluid* $C_{14}H_{14}N_2$; similarly he has obtained with nitrocymol, *azocymid* in the form of micaceous colourless plates. With nitroxylol and nitrocumol he has procured bodies which he has not yet analysed, but which must be *azoxylid* and *azocumid.* Bodenbender gives a "*Notice of the Action of Mannite on Oxide of Copper in Alkaline Solution.*" The products of this reaction are not constant, as in the case of grape sugar. Among the products the author found an organic acid, the nature of which he has not yet determined. We may add that he tried various means for transforming mannite into grape sugar, but met with no success.

Journal für Prakt. Chemie. No. 21. 1864.

This number contains two papers of interest to mineralogical chemists. One is by Professor Kenngott "*On the Composition of Staurolite;*" and the other, by Dr. C. Bischoff, "*On the Quantitative Estimation of the Alkalies in Basalt in Different Conditions.*" The next paper is by Professor Schrotter, "*On a Simplified Process for Extracting Lithium, Rubidium, Cæsium, and Thallium from Lithia, Mica, and Lepidolite.*" We shall give an account of this process. A short paper, by Liebig, "*On Extractum Carnis,*" insists on the usefulness of this preparation, and strongly recommends its preparation and exportation to Europe from South America and other countries where meat is cheap. In England we shall probably prefer to have the beef itself at 3d. per pound. Three papers by Gentele follow—"*On Some Platinum Bases;*" "*On the Aldehyd of Formic Acid;*" and "*On Chemical Formulæ.*" These will only interest advanced chemists.

NOTICES OF PATENTS.

1036. *Puddling Iron, Steel-iron, and Steel.* H. Bennett, Wombridge, Salop. Dated April 23, 1864.

This invention consists of an improved method of puddling iron or steel by subjecting the pigs to a strong heat prior to their introduction into the body of the puddling furnace. This object is attained by placing hollow bars, through which a stream of cold water is kept constantly running, either over the firegrate or over the body of the furnace at a distance of about six inches beneath the crown; the pigs are introduced through a door at the end of the furnace placed above the usual fire door, and are laid upon the water bars, where they become heated during the working of a previous charge, so that by the time the first bloom is formed and removed from the furnace, the second charge of pig, above it, is nearly in a melting condition, and when now transferred to the bed of the furnace very quickly enters into fusion, while the spare heat is, as before, made available for the preliminary heating of a fresh charge of pig iron.

The process here described cannot fail to prove advantageous as a means of economising fuel, and the mechanical arrangements are such as would be applicable to existing furnaces. As a further improvement in the same direction, we would suggest that the blast furnace be surrounded, or placed in communication, with a series of puddling chambers, into which separate charges of the molten iron could be run directly after its reduction; or, if an intermediate process of purification must be resorted to, the refinery furnace may become the centre from which to draw supplies of the fluid metal.

1060. *Producing Photographic Pictures Photogenically Indelible.* R. A. Brooman, Fleet Street, London. A communication. Dated April 27, 1864.

The objects contemplated in this invention are the production of photographs upon, or transfer of photographs to, the surfaces of porcelain, glass, rock crystal, lava ware, or amianthus fabrics, and afterwards burning them in with fluxes as in the enamelling processes. Or, the ordinary photographs upon glass may be intensified by any of the known processes, and the silver thus deposited be firmly attached to the glass by the action of fire; or, lastly, salts of gold and platinum may be used to modify the colour of the pictures, and confer additional permanence. In some cases it is intended to convert the film of pure metal into chloride or iodide by exposing the surfaces to chlorine gas or to the vapours of iodine, and then to promote the attachment of such compounds of silver to the glass by the application of a moderate heat. The use of pigments is also mentioned in the specification.

1083. *Manufacture of Iron.* W. C. **Cambridge**, Bristol. Dated April 29, 1864.

The patentee mixes broken or powdered iron ore with clay, limestone, or other suitable flux, and adds scrap or waste iron in the form of turnings or borings, and makes them up with water into plastic masses, from which blocks are afterwards formed suitable for charging the blast furnace.

A similar method of proceeding was tried some years ago in connection with the Taranaki iron sand, but we do not know whether the scheme proved successful.

1124. *Compound or Composition for Artificial Stone.* H. **Potter**, Manchester. Dated May 4, 1864.

The inventor prepares a hard and durable material which is suitable for many purposes to which stone is now applied, by mixing together sand and iron filings or borings, making them into a paste with water, and allowing the mass to harden by the operation of rusting whilst enclosed in caissons or suitable boxes. The proportions recommended are ten parts by weight of sea or river sand to one of the cast or wrought iron borings.

1128. *Apparatus for Securing Stoppers for Bottles.* J. **Thompson**, Hilldrop Crescent, Camden Town, London. Dated May 4, 1864.

With the view of preventing mistakes in dispensing, the inventor makes use of a capsule cover for securing the stoppers of all bottles containing poisonous tinctures, &c. The said cover is made of a little disc of metal having an aperture cut out of it which passes over the square head of the stopper, and, by a little binding screw on one side, is fastened to the neck of the bottle, whilst a tag or loop on the other side completes the arrangement.

1185. *Blast Furnaces.* M. **Morgan**, Brendon Hills, Somersetshire. Dated May 10, 1864.

This invention relates to the construction of blast furnaces with a central core, through which, if desired, may be established an air blast. The core is made of a conical shape, and may be either solid or hollow, and rise to any desired height in the centre of the furnace; the ordinary tuyeres are employed conjointly with the central blast.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

2605. L. P. La Ciotat, France, "An improved antisaline coating, chiefly applicable for preserving from corrosion and incrustation the boilers and pipes of marine steam engines."—Oct. 21, 1864.

2684. B. R. Keith, Ingram Court, London, "A new article of farinaceous food." A communication from J. Candler, Boston, U.S.A.—Oct. 29, 1864.

2073. J. Ramsbottom, Crewe, Cheshire, "Improvements in the manufacture of steel and iron, and in the apparatus employed therein."

3075. E. Brooke, the younger, Huddersfield, Yorkshire, "An improvement in the manufacture of glass-house pots."—Dec. 12, 1864.

3116. J. Ellis, North Ormesby, Yorkshire, "Improvements in furnaces used in the manufacture and the heating and melting of iron, which improvements are also applicable to other furnaces."—Dec. 16, 1864.

3191. J. Paterson, Dundee, N.B., "Improvements in the treatment of jute and other fibrous substances, and in the machinery, apparatus, or means connected therewith."—Dec. 19, 1864.

3214. H. Hicklin, Wollaston, Worcestershire, and Parade, Brierly Hill, Staffordshire. "Improvements in the construction of coke ovens."—Dec. 27, 1864.

3221. J. Cleaver, Canterbury Place, Walworth, Surrey. "Improvements in the manufacture of Portland cement."

3222. J. R. Breckon, Darlington, Durham, and R. Dixon, Crook, Durham. "Improvements in the construction of coke ovens."—Dec. 28, 1864.

3245. A. S. Macrae, and A. Bayley, Liverpool, Lancashire. "Improvements in the burners of hydrocarbon fluid lamps."—Dec. 30, 1864.

5. J. F. Parkes and J. Tanner, Birmingham. "Improvements in the manufacture of oxygen gas, and in treating and economising the residual products of the said manufacture."

9. Robert Irvine, Musselburgh, N.B. "Improvements in treating the pitch obtained in, or resulting from, the distillation of palm oil and other fats in candle-making."—Jan. 2, 1865.

15. L. D'Aubreville, Paris, France. "Improvements in manufacturing paper." A communication from J. J. Mancey, Fures, département de l'Isère, France.—Jan. 3, 1865.

Notices to Proceed.

2105. C. G. Lundborg, Sodertelje, Sweden, "An improved mode of extracting oils from coal or other bituminous substances yielding hydro-carbon oils."—Aug. 26, 1864.

2116. P. A. le Comte de Fontaine Moreau, Rue de la Fidélité, Paris, France, "Certain improvements in the manufacture of artificial stone."—A communication from C. Pasquin, Verdun, France.—Aug. 27, 1864.

2132. A. Smith, Hackney, Middlesex, "Improvements in machinery for applying paste and other liquid adhesive material colour and paint to paper and other substances."—Aug. 30, 1864.

2156. J. F. P. Hugouneuq, Lodève, Départment de l'Hérault, France, "An improved method of obtaining indigo from textile materials, either yarns or fabrics, previously dyed by the blue soaking process."

2157. W. L. Duncan, Hunter Street, Brunswick Square, Middlesex, and S. C. Child, The Grove, Clapham, Surrey, "Improvements in bleaching coloured and other rags or other materials, or half stuff, and in rag engines for paper making."—Sept. 2, 1864.

2177. D. Walker, Liverpool, "Improvements in arrangements for malting."

2178. T. H. Baker and T. Woodroffe, Tunbridge, Kent, "Improvements in filtering apparatus for filtering water and other liquids."—Sept. 6, 1864.

2385. N. Thompson, Abbey Gardens, St. John's Wood, Middlesex, "Improvements in stoppers for bottles and other vessels."—Sept. 28, 1864.

3049. A. D. Hall, Glasgow, Lanarkshire, N.B., "An improved compound for coating the bottoms of ships and structures wholly or partially immersed in the sea or tidal estuaries, and in the system or mode of preparing the same."—Dec. 7, 1864.

CORRESPONDENCE.

Continental Science.

Paris, January 19.

Fancy a number of people at work by lamp-light around a table two yards in diameter, at what height should the flame of the lamp be placed to give the maximum of light at what we may call the working distance on the table—say half a yard from the circumference? This is a question which M. Breton, of Grenoble, has set himself to solve; and I give your readers the benefit of his solution. I have given a rough approximation of his French measures to save you trouble. Well, M. Breton states that the height should be equal to seven-tenths of the radius of the circle, but it may be raised to the whole radius, or brought down to half without making much difference. But at greater distances the loss of light at the working distance is very considerable. The author has gone further, and applied his investigations to street-lighting, deciding at what height gas lamps should be placed to light up extended distances. The same rule as above applies in this case. The height of the jet should be seven-tenths, or about two-thirds of half the distance between two lamps. This would in most cases give us inconveniently tall lamp-posts; but M. Breton here makes a suggestion which may deserve some attention. He recommends that a greater number of smaller jets should be employed, and the lamps be placed nearer together. Supposing, for example, that the amount of gas consumed in one jet be divided between three smaller burners placed at thirds of the space between two taller lamps; the intensity of each light will now, he says, be three times less, but the squares of the distances will also be three times less, and consequently there will be three times the amount of useful light for the same consumption of gas. These notions, as I have said, may deserve the attention of those who are concerned in the lighting of London streets, which, it must be admitted, is open to improvement. M. Breton recommends the electric light for street illumination—not one intense, but a number of small ones, such as the miner's lamp invented by M. Dumas, of Privas. This is a small lamp, giving about the light of one candle, which the miner can carry on his back. The current is not passed from carbon points, but is carried into a sort of electric egg, a glass flask partially exhausted of air. These give a very soft light, and are capable, M. Breton thinks, of modification for the lighting of public ways. They may be, perhaps, when we have discovered a cheap source of the electric force.

An ingenious thought has also struck M. Agudio, who proposes to cleanse the streets with a pneumatic machine. He has invented a mud-cart, consisting of a close iron box, from which the air is pumped by a small engine on the top. Some machinery behind, as the cart moves on, sweeps or rakes the mud together, which is, of course, sucked up by a tube dipping into it, and brought from the upper part of the cart box.

To count the grains of sand on the sea-shore has generally been considered a tedious, if not an impossible operation. Similarly, it might be supposed a difficult matter to count the drops in a shower of rain. M. Herve Mangon, however, proposes to do this in a very simple way. For this purpose he impregnates a paper screen with sulphate of iron, and faces it with a mixture of very finely-powdered nutgall and gum sandarac. Drops of water falling on this screen will make a black spot. If now the screen be placed on a drum which makes a complete revolution in twenty-four hours, successively exposing parts of the screen to the rain, the duration of the shower and the number of drops will be clearly indicated by the black spots; and the time, the space of paper exposed at each moment, and the area covered by the shower being known, the rest becomes a simple arithmetical operation. The apparatus can also be arranged to show the direction of the fall, and also, it is said, to determine the weight of the drops.

I will just mention, for as much as it is worth, a discovery made by a M. Mace, who calls himself a professor of chemistry. He says that he has obtained a very cheap illuminating agent, an oil having the formula $C_7H_7O_9$, and the density 1·09, by distilling the kernels of the little cherry fruit of *Cerasus avium* used in the preparation of Kirschenwasser. The oil costs, he says, from 55 to 60 centimes per litre, and a litre will supply a lamp giving the light of two gas jets for twenty-three or twenty-four hours.

Dr. Hofmann's Exhibition Report.

To the Editor of the Chemical News.

Sir,—My attention has been called to an article in the Chemical News of the week before last relating to the publication of the jury reports of the Exhibition of 1862. As it appears based on a misapprehension of the facts, and my name is quoted in it, may I beg the favour of your permitting me to offer a correction?

The Commissioners of the Exhibition of 1862 had nothing whatever to do with the publication—indeed, it was in consequence of the Commissioners, for reasons unnecessary here to enter upon, determining not to issue any jury reports, that the Society of Arts, who had originated the Exhibition, and obtained from the Crown the Charter incorporating the Commissioners, and who felt the importance of securing an authentic record of it, resolved to publish jury reports at its own expense and risk, if the jurors would undertake the task of furnishing the reports. The arrangement was made and the work advertised at 15s. the volume to the public, the members of the Society of Arts, and those connected with the Exhibition being permitted to subscribe for copies at 10s. The original intention was to bring out the volume before the close of the Exhibition, but owing to the difficulty of getting the MSS. of the reports from the jurors completed in time, this was found impossible, and it was determined to issue to the subscribers and sell separately in the building and elsewhere such of the reports as were ready. This was done, and the sale of those and other reports as they were completed was kept on until the whole were complete and the volume issued. The chemical report which is referred to in the Chemical News was the last or nearly the last that was completed, Dr. Hofmann being determined to make it as perfect as possible, and sparing no time or pains to effect the object.

On the completion of the volume the reports were no longer sold separately, and hence no separate copies of this report, as well as of some others furnished contemporaneously, were on sale. A sufficient number of reports were printed to complete subscribers' sets, and an edition of the complete volume was printed for sale to the public as large as was thought justifiable on the part of the Society to publish, it not being a trader who might speculate on retaining a remainder stock.

The edition is now exhausted, but I think I may venture to say that if a sufficient number of subscribers were guaranteed the Council of the Society of Arts would be ready to reprint the whole or any one of the jury reports that might be desired.

The Society of Arts in bringing out the jury reports involved itself in a considerable pecuniary loss, but it was considered a public duty to undertake the publication, and a legitimate and proper application of its funds.

I am, &c. P. Le Neve Foster.

Society of Arts, Manufactures, and Commerce, Adelphi,
London, W.C., January 17.

P.S.—I may add that Her Majesty's Commissioners subscribed for a large number of copies, which were presented to foreign governments, commissioners, jurors, and others.

Alcohol from Apples.

To the Editor of the Chemical News.

Sir,—Last spring I made some experiments on windfalls from apple trees, with a view of utilising them by making spirit from them. This would probably be found a more economical application of using them than using them for feeding pigs, as is done now, for pigs will eat anything; they eat coals with great relish.*—I am, &c.

Arthur Reynolds, B.Sc.

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* Would our correspondent consider carbon taken in this form as respiratory food?—Ed.

Revivification of Animal Charcoal.

To the Editor of the Chemical News.

Sir,—My attention has been called to your notice of Mr. Beanes' patent for "treating animal charcoal" in your number dated January 7. As the writer has, to some extent, misapprehended the object of the patented process, I beg you will allow me, on behalf of my friend and coadjutor, Mr. Beanes, to give to your readers an explanation.

Early last year Mr. Beanes patented a process for removing the lime and carbonate of lime from the animal charcoal used in sugar refineries, by treating the dry black with dry hydrochloric acid gas, and subsequently washing out the chloride of calcium. On May 4 he patented the use of the materials named in the specification you refer to, and which answered to some extent; but, finding the dry hydrochloric acid gas to be not only much cheaper, but far more efficacious, he abandoned the second patent, considering it of little or no value.

Every ton of raw sugar refined in England contains from 7 to 10 lbs of lime, the remains of that which has been used in the country of production to neutralise the acids of the cane-juice. It is this lime which chokes up the pores of the animal charcoal, and renders it inefficacious as a decoloriser. The removal of this lime from the spent charcoal has hitherto been to the refiner an insurmountable difficulty, but Mr. Beanes, who has had more than twenty-five years' experience in the sugar plantations of Cuba, has, for some years past, devoted his great chemical and scientific knowledge to the solution of the problem. How far he has succeeded in removing the lime and carbonate of lime, without attacking the phosphate, and so injuring the bony structure of the charcoal, is best proved by the fact that the largest sugar refinery in New York—that of Messrs. Havemeyer and Elder—have been using the process for six months, and they effect not only a saving of 100 per cent. of charcoal, but they get a larger produce of sugar, and of a finer quality. I am, &c.

Hy. Medlock.

Chemical Laboratory, 20, Great Marlborough Street, W.

Destruction of Parasites.

To the Editor of the Chemical News.

Sir,—Noticing in the Chemical News for January 7 a reference to petroleum as destructive to parasites on the human body, I desire to say that my attention has been for a considerable period directed to the application of chromic acid or bichromate of potash for the same object, having applied it to ringworms and every other skin disease with complete success, and having also applied this acid to animals, especially to cows' feet, with the same satisfactory results. In preparing the solution, I use one ounce of bichromate dissolved in six ounces of water, then apply the solution to the place affected, one dressing generally being sufficient. I may remark that this solution should not be used too often, because by its repeated application the caustic effects of the acid will cause a wound. But this is not at all dangerous. My experience in the application of this acid has been very long, and I never found it to fail in destroying parasites.

I am, &c. Israel Swindells,
Scientific and Analytical Chemist.

Lansdown Terrace, Wigan.

Purification of Oil of Bitter Almonds.

To the Editor of the Chemical News.

Sir,—I should feel obliged if you would permit me to set right one or two little errors that have crept into your report of the meeting at the Pharmaceutical Society on the 4th inst.

In the first place, I did not bring forward the formation of a compound of the benzoic aldehyd with bisulphite of sodum as a new chemical fact, but merely suggested its application to the purification of crude oil of almonds.

You say afterwards that "Mr. Tilden remarked that the hydrocyanic acid did not exist in the oil as a cyanide. It was probably furnished by benzamide." I believe the substance of my observation was this: that the hydrocyanic acid, which makes its reappearance in certain specimens of the essential oil purified in the ordinary way, might not exist there in the form of a cyanide, but would more probably result from the splitting up of such a body as the so-called "benzimide."

$$C_{46}H_{18}K_2O_4 + H_2O_2 = 3C_{14}H_6O_2 + 2HC_2N.$$

I am, &c. William A. Tilden.

17, Bloomsbury Square, January 17, 1865.

Water Analyses.

To the Editor of the Chemical News.

Sir,—I observe in the last number of the Chemical News an analysis of the Llandudno water, by Dr. Muspratt, in which silicate of soda is given as one of the ingredients. This appears to me to be a mistake, as the presence of chloride of magnesium and some of the other substances set forth in the analyses would be incompatible with the existence of silicate of soda.

I have been induced to notice this, as what I consider the same error occurs in an analysis of Moffat water by Dr. John McAdam. I am, &c.,

Alex. Whitelaw.

55, Sidney Street, Glasgow.

MISCELLANEOUS.

Royal Institution.—The following are the arrangements for the ensuing week:—Tuesday and Thursday, January 24 and 26, at 3 o'clock, Professor Tyndall, F.R.S., "On Electricity." Friday, January 27, at 8 o'clock, General Sir H. Rawlinson, K.C.B., "On the Results of Cuneiform Writing to the Present Time." Saturday, January 28, at 3 o'clock, Professor Marshall, F.R.S., "On the Nervous System in Man and Animals."

Simpson v. Holliday.—On Saturday last the Lord Chancellor gave his decision in this case, reversing the judgment of Vice-Chancellor Wood, and declaring Medlock's patent invalid. The Lord Chancellor said it had been asserted that the dye in question was capable of being manufactured by a double process—hot as well as cold—and the question appeared in truth to turn on that. He was of opinion that, as far as that was concerned, the specification was untrue; but as there was a probability of the case being carried to the House of Lords, he would simply reverse the order made by the Vice-Chancellor, and dissolve the injunction. The patent was null and void, but he would not dispose of the other issues raised upon the trial, because the consequences of the opinion as to the patent were obvious. Of course, where there was no patent there could be no infringement; but in the event of the House of Lords reversing his Lordship's decision, then the question of infringement would be tried. This celebrated case is a notable illustration of the "glorious uncertainty" of the law, and also of need of a proper tribunal for the trial of such actions.

Thermometer Alarum.—M. Morin has devised an instrument which may be susceptible of many useful applications. A green-house, for example, must be kept at an uniform temperature, but it may not be convenient to keep a man to continually observe the thermometer, and attend to the fire. M. Morin has therefore contrived an instrument which will give notice whenever the temperature of the conservatory falls below the desirable point. It consists of an ordinary thermometer, into the bulb of which a platinum wire is carried, another being brought through the top down to the point marking the degree of heat required. These wires are placed in connection with a small battery and an electric alarum. It will now be seen that as long as temperature is maintained the circuit is complete, but as soon as the mercury falls below the platinum wire the circuit is broken, and a small electro magnet lets fall an armature, which completes a circuit with the alarum. This now begins to ring, and continues to do so until the temperature rises again to the proper height. Different adaptations of this instrument may make it useful in giving indications of changes of temperature in many industrial operations.—*Comptes Rendus.*

Revision of the Medical Act.—It is said, on something like authority, the Medical Council are engaged on a revision of the Medical Act, with the view of bringing an amended bill before Parliament in the ensuing session. We make the announcement now, that those of our readers interested may be on the alert. On a future occasion we shall probably make some remarks on the subject.

Irish Metallurgical and Chemical Manufactures.—The absence from Ireland of any abundant deposits of bituminous coal such as occur in this island, and on which gift of nature has been built up the colossal fabric of England's industrial power, necessarily prevents the establishment in that country of those branches of trade in which the cost of fuel forms any very large proportion of the total cost of production. Hence, although possessing in abundance deposits of the richest iron ores, we have not had any successful establishment of iron smelting in recent times. The iron ores, however, both as earthy carbonate and as hematite, are now largely exported from Ireland to this country to supply the enormously increased demand. Similarly, although large quantities of copper ore are raised in Ireland, principally in the southern counties of Cork and Waterford, the ore is shipped to Swansea to be smelted, as the large proportion of fuel which is required in smelting copper would render the progress in Ireland too costly to be profitably carried on. In the case of the ores of lead and silver, however, the proportion of fuel necessary is not so large, and not merely are all the lead and silver ores raised in Ireland smelted in the vicinity of Dublin, but a large quantity of foreign ores of those metals are imported for Irish smelting works, the produce from which is highly esteemed, not merely in the local but in the British markets. I believe that this department of mineral industry will be found very efficiently represented by Irish smelters in the coming Exhibition. Although the smelting of iron ores and the actual manufacture of iron is not now carried on in Ireland, yet there is a very large amount of trade in the making of machinery, especially for the linen manufacture, of steam engines and water-wheels, and of late years of iron ships. This latter business has already assumed large proportions. A very large branch of mining industry in Ireland, that of iron pyrites or sulphur ore, becomes the basis of an extensive series of chemical manufactures, which, however, are limited, just as in the case of iron smelting to those branches in which the cost of fuel does not form a preponderant proportion of the total cost of manufacture. In Dublin, Cork, and Belfast, large quantities of sulphuric acid, of chloride of lime, sulphate of soda, &c., are made; the important branch of alkali making, as caustic and carbonate of soda, however, is not, as I believe, carried in Ireland beyond the manufactures of sulphate of soda.—*Sir R. Kane's Lecture.*

The Odour of Flowers, and the Enfleurage Process.—The odours of flowers do not, as a general rule, exist in them as a store or in a gland, but they are developed as an exhalation. While the flower breathes it yields fragrance, but kill the flower, and fragrance ceases. It has not been ascertained when the discovery was made of condensing, as it were, the breath of the flower during life; what we know now is, that if a living flower be placed near to butter grease, animal fat, or oil, these bodies absorb the odour given off by the blossom, and in turn themselves become fragrant. If we spread fresh unsalted butter upon the inside of two dessert-plates, and then fill one of the plates with gathered fragrant blossoms of clematis, covering them over with the second greased plate, we shall find that after twenty-four hours the grease has become fragrant. The blossoms, though separated from the parent stem, do not die for some time, but live and exhale odour, which is absorbed by the fat. To remove the odour from the fat, the fat must be scraped off the plates and put into alcohol; the odour then leaves the grease and enters into the spirit, which thus becomes "scent," and the grease again becomes odourless. The flower farmers of the Var follow precisely this method on a very large scale, with but little practical variation, with the following flowers: rose, orange, acacia, violet, jasmine, tuberose, and jonquil. The process is termed, as said before, *enfleurage* or inflowering. In the valley of the Var there are acres of jasmine, of tuberose, of violets, and the other flowers named. In due season the air is laden with fragrance—the flower harvest is at hand. Women and children gather the blossoms, which they place in little panniers like fishermen's baskets hung over the shoulders. They are then carried to the laboratory of flowers and weighed. In the laboratory the harvest of flowers has been anticipated. During the previous winter great quantities of grease, lard, and beef-suet have been collected, melted, washed, and clarified. The great success of this process depends on the absolute purity of the grease employed, and no pains are spared to this end. In each laboratory there are several thousand *chassis* (sashes), or framed glasses, upon which the grease to be scented is spread, and upon this grease the blossoms are sprinkled or laid. The *chasse en verre* is, in fact, a frame with a glass in it as near as possible like a window-sash, only that the frame is two inches thicker, so that when one châsse is placed on another, there is a space of four inches between every two glasses, thus allowing room for blossoms. Every châsse, or sash, is about two feet long by eighteen inches broad. The flower blossoms are changed every day, or every other day, as is convenient to the general work of the laboratory or flowering of the plants. The same grease, however, remains in the châsse so long as the particular plant being used yields blossoms. Each time the flowers are put on, the grease is "worked"—that is, serrated with a knife—so as to offer a fresh surface of grease to absorb odour. The grease being inflowered in this way for three weeks or more—in fact, so long as the plants produce blossoms, is at last scraped off the châsse, melted, strained, and poured into tin canisters.—*Dr. Piesse's Lecture.*

ANSWERS TO CORRESPONDENTS.

⁂ All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. *Private* letters for the Editor must be so marked.

X.—Annal. de Chim. et de Physique, 3, 195, and *Journ. für Chem.* 25, 401.

Currier.—Vol. X. of the Chemical News, just completed, contains the Cantor Lectures, "On Chemistry Applied to the Arts," delivered at the Society of Arts, by Dr. F. C. Calvert.

Chem.—The last traces of carbonaceous matter may be got rid of by the addition of a little dry nitrate of ammonia, but you must add it carefully and in small quantity, or some of the contents of the crucible may be projected.

Received.—C. J. Richardson; Helidays.

Books Received.—"American Journal of Pharmacy;" "The Philadelphia Photographer."

⁂ Will our American correspondents kindly take care to properly affix the stamps, which, we presume, originally accompany the journals they send us?

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

An Introduction to Chemical Philosophy, according to the Modern Theories, by ADOLPHE WURTZ, *F.R.S.*

PART I.

EQUIVALENTS, ATOMIC WEIGHTS AND MOLECULAR WEIGHTS.

SECTION I.—*Historical Development of the Ideas, Equivalent, Atom, Molecule.*

BODIES combine in definite proportions; this is one of the fundamental truths of chemistry. The notions of equivalents, of atomic weights, and of molecular weights are a consequence of it, and the idea of regarding chemical compounds as molecules formed of a juxtaposition of atoms is its theoretical representation. These ideas are involved in all that appertains to chemistry, and are the basis of all discussions connected with the science. It is important, therefore, to look for their origin and development, and to examine how, from being for a long time ill defined and confused, they have ultimately assumed the definite forms which they now possess.

Definite Proportions.—Equivalents.—The ideas of definite proportions have become introduced into science by researches into the composition of salts. It was found that in order to saturate a definite weight of alkali with an acid of known strength, it was necessary to employ an invariable weight of the latter; and it was observed that the formation of a neutral salt depended upon the existence of a fixed relation between the amounts of real alkali and acid present, the least excess of one or the other being sufficient to destroy the neutrality.

In 1699 Homberg[*] undertook some experiments on this point which deserve to be mentioned. He found that 1 ounce of salt of tartar (carbonate of potash) required to saturate it,—

14 ounces of the best vinegar.
2 ounces 3 drachms of spirit of salt (hydrochloric acid).
1 ounce, 2 drachms, 36 grains of aquafortis (nitric acid).
5 drachms of vitriolic acid.

After evaporating the saturated liquids the increase in weight of the solid matter was,—

3 drms.	36 grs.,	after saturation	with	vinegar.
3 „	14 „	„	„	hydrochloric acid.
3 „	36 „	„	„	nitric acid.
3 „	6 „	„	„	sulphuric acid.

It is seen that these experiments have for their object the determination of the quantities of different acids which are required to saturate the same weight of base. Inaccurate as are their results, they amount to an attempt, crude, indeed, but the earliest, to determine what we today call the equivalents of acids.

Nearly a century elapsed before the question of the composition of neutral salts, started by Homberg, received a satisfactory solution. Bergmann and Kirwan examined it with but moderate success, and it is somewhat remarkable that it was reserved for one of the last upholders of alchemy—Wenzel[†]—to settle this point.

The work written by this chemist in 1777, under the title of "Vorlesungen über die Chemische Verwandschaft der Koerper" (Lessons on the Chemical Affinity of Bodies), is even now remarkable for the accuracy of the analyses there described, and for the justness of the conclusions which the author knew how to deduce from them. The starting point of these researches was the following phenomenon, which was then well known, and which had already been observed by chemists:—

When concentrated and neutral solutions of sulphate of potash and nitrate of lime are mixed together, there are formed, by double decomposition, sulphate of lime which is precipitated, and nitrate of potash which remains in solution. The two newly formed salts are neutral, like the former, and it is the permanency of this neutrality which requires explanation.

Wenzel found this explanation in the composition of the four salts under examination. Having analysed the nitrate of lime, he found that 363 parts of this salt contained 123 parts of lime and 240 parts of nitric acid. He then tried how much sulphate of potash he should have to take for the lime to be completely precipitated by the sulphuric acid. Experiment had shown him that 162·5 parts of lime neutralised 240 parts of sulphuric acid, and he concluded from this that 123 parts of lime ought to require 181·5 parts of sulphuric acid.

On the other hand, he found that 240 parts of sulphuric acid required for neutralisation 290·4 of potash; 181·5 of sulphuric acid should therefore require 220 parts of potash; and to completely precipitate the lime from 363 parts of nitrate of lime it would be necessary to take 181·5 + 220, or 401·5 parts of sulphate of potash.

The 304·5 parts of sulphate of lime (containing 123 parts of lime and 181·5 parts of sulphuric acid) being precipitated, Wenzel concluded that the 240 parts of nitric acid originally combined with 123 parts of lime, ought, in order to form a neutral salt, to unite with the 220 parts of potash originally combined with the 181·5 parts of sulphuric acid. An analysis of nitrate of potash proved that his conclusion was correct; for he showed experimentally that 240 parts of nitric acid united with 222⅔ parts of potash, an amount differing very little from 220.[‡]

The important deduction from these researches is this: when nitrate of lime and sulphate of potash are mixed together in such proportions that the lime of the first salt will be neutralised by the sulphuric acid of the second, the nitric acid left by the lime is *precisely the amount* necessary to neutralise the potash abandoned by the sulphuric acid.

In other words, when two neutral salts mutually decompose each other, the neutrality is maintained for the reason that the amount of base which is neutralised by a certain weight of one acid, is also neutralised by a definite weight of another acid.

Hence arises the idea of equivalency. We have here two acids and two bases. The same quantities of each base neutralise successively a given weight of each acid, and are consequently *equivalent* to each other; thus:—

123 parts of lime } neutralise successively
222 parts of potash } 240 parts of nitric acid,

and are, consequently, equivalent in relation to this weight of nitric acid.

123 parts of lime } neutralise also 181·5 parts
222 parts of potash } of sulphuric acid.

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[*] Hermann Kopp, *Geschichte der Chemie*, ii., 355.

[†] Charles Frederick Wenzel was born at Dresden in 1740 and died in 1793, being at that time the director of the famous mines of Freiberg, in Saxony. He published in 1773 a work entitled "An Introduction to the Higher Chemistry" (Einleitung zur Höheren Chemie) and devoted it to the defence of alchemical ideas.

[‡] 363 parts of nitrate of lime contain 123·9 of lime and 239·1 of nitric acid; these figures are almost identical with the figures 123 and 240 obtained in Wenzel's analysis.

401·5 parts of sulphate of potash contain 184·5 parts of sulphuric acid and 217 of potash. Wenzel found in it 181·5 of sulphuric acid and 220 of potash. A comparison of these numbers will give a good idea of the accuracy of his analyses.

and are, therefore, equivalent in respect to this weight of sulphuric acid.

It suffices, therefore, to determine the proportions in which two bases combine with an acid to know also the proportions in which these bases will unite with another acid.

In these memorable experiments it was necessary to determine the composition of nitrate of lime, and that of sulphate of potash, also to find what quantity of sulphuric acid was necessary to saturate the lime in the nitrate, and then to know how much nitric acid was necessary to saturate the potash in the sulphate. The composition of nitrate of potash was then foreseen by theory: 240 parts of nitric acid required 220 of potash. This is the amount predicted theoretically; 222·5 is the experimental quantity. Thus, Wenzel not only introduced into chemistry the idea of equivalency, but, at the same time, he foresaw and predicted the conclusions that could be drawn from it respecting the theoretical calculation of the composition of salts and the control of analyses.

Researches so exact and so important were scarcely noticed by chemists at that time, and were soon quite forgotten. The time for Wenzel had not yet arrived; his contemporaries were discussing theoretical ideas of a higher order; every one was excited by the teachings and astonishing discoveries of Lavoisier.

(To be continued.

On the Supposed Nature of Air prior to the Discovery of Oxygen, by GEORGE F. RODWELL, *F.C.S.*

(Continued from Vol. x., page 210.)

10. Robert Hooke.—Robert Hooke was born in 1635; in 1653 he went to Oxford, where he made the acquaintance of Boyle, who was so struck with his aptitude for devising experiments and constructing apparatus that he engaged him as his assistant; and these two greatest experimental philosophers of the age immediately succeeding that of Bacon worked together for several years on numerous branches of science. Hooke was a man of great erudition—his writings relate to all the physical sciences known at the period; he excelled greatly as a mechanician, and his inventions are said to number more than a hundred; among others we may mention the circular pendulum, the wheel barometer, and instruments to graduate thermometers, to measure time with exactness, to determine the refractive power of liquids, to grind optical glasses, and to show the number of vibrations of a string requisite to produce a certain note; moreover, he greatly improved the microscope and telescope.

Hooke's first scientific treatise* was published in 1661; in it he endeavoured to explain the cause of some effects observed by Boyle, as to the rise of water in tubes of small diameter. It was the ingenuity of this treatise which first brought Hooke before the notice of the recently formed Royal Society, and it was immediately proposed that he should be requested to act as curator to the Society. To this office he was elected on November 12, 1662, and it was ordered that he should be required to show "three or four considerable experiments" whenever the Society met; a vote of thanks was passed to Boyle for dispensing with the services of so valuable an assistant.

At the following meeting (November 19) Hooke showed some experiments to prove the weight of air. A globe of glass, the interior of which communicated with the air by a tube of small diameter, was heated to bright redness, and sealed before the blowpipe; when cool it was placed in the scale of a balance, and counterpoised by weights in the opposite scale; on now breaking off the end of the tube so as to admit air to the globe, the latter preponderated. Into a similar globe a small quantity of water was introduced, which was completely evaporated, the globe heated to redness, sealed before the blowpipe, and counterpoised as in the previous experiment; on admitting air the globe preponderated, and the weight of air which had entered was shown by placing weights on the opposite scale, until equilibrium was restored. On December 3 he varied the experiment: two small glass globes one and a-half inch in diameter were sealed at the ordinary temperature, and suspended from one end of the beam of a balance in such a way that the globes preponderated; the balance was introduced into an air-tight vessel into which air was condensed, the globes now ceased to preponderate; on allowing the condensed air to escape from the vessel, the globes returned to their former position.

In 1664 Hooke presented the manuscript of his "Micrographia"† to the Royal Society, and the President, by an order dated November 23, 1664, ordered it immediately to be printed. The "Micrographia" is chiefly devoted to the description of microscopic bodies, but it also contains a great amount of experimental observation in various branches of natural philosophy, particularly in optics; it is in every way worthy to be among the first works published by a Society instituted for the purpose of investigating natural phenomena by experiment.

In the preface Hooke describes the wheel barometer which he had recently devised for showing minute changes in the pressure of the air; the circle was divided into 200 parts, but there were no indications upon it to show what kind of weather might be expected when the index stood at a certain point. From a number of observations Hooke found that the mercury invariably fell before rainy weather, and that it rose before dry weather and during the prevalence of an easterly wind.

The air, according to Hooke, is a mixture of terrestrial and aqueous particles, "dissolved and agitated by the ether;" and just in the same way that a few grains of salt may be diffused through a large quantity of water, so, he says, a small quantity of air may expand and diffuse itself through a large space; on the other hand, as a small quantity of water is able to dissolve a quantity of salt which could diffuse itself through a large quantity of water, so a quantity of air which could expand and diffuse itself through a large space may be contained within a small compass.

In the 7th observation of the "Micrographia" Hooke describes the spirit thermometer, which he introduced into England, and which had been invented a few years previously by one of the members of the Accademia del Cimento, Hooke constructed thermometers of such delicacy that although the stem was four feet long the spirit rose nearly to the top of the tube in summer, and sunk nearly to the bulb in winter:—The freezing point of water was the zero of the scale.

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* This treatise extends over fifty small pages; it is entitled "An attempt for the explication of the phenomena observable in an experiment published by the Hon. Robert Boyle, in the 35th experiment of his epistolical discourse touching the air. In conformation of a former conjecture made by R. H." London: 1661. Hooke re-published this treatise four years later in the "Micrographia." (Obs. 6, "Of small glass canes.")

† "Micrographia, or some Physiological Descriptions of Minute Bodies made by Magnifying Glasses." London. 1665.

Observation 9 is entitled, "of the fiery sparks struck off from a flint or steel." It was anciently believed that when flint and steel are struck together sparks are produced by the attrition of the air; Lucretius supposed that lightning is produced by the collision of two clouds, in the same way that sparks are produced by the collision of flint and steel. Bacon‡ mentions that the sparks descend, and when extinguished are found to be a kind of "dark ash;" he affirms, moreover, that they are in reality particles struck off from the flint or steel, raised to ignition by the violence of the friction. Des Cartes endeavoured to explain the production of the sparks according to his three-element theory,§ and in so doing gave a most obscure and unphilosophical explanation; this induced Hooke to examine the phenomenon for himself. Accordingly he collected a number of the particles which had appeared as sparks of fire when first struck off from the steel, and examined them under the microscope; they were then seen to be spheres with a metallic lustre, so bright that bodies could be seen reflected in them. The sparks are, therefore, he contends, minute particles of steel which by the violence of the friction are raised to a red heat, and then take fire and burn, because "there seems to be a very combustible sulphureous body in iron or steel, which the air very readily preys upon, as soon as the body is a little violently heated."

(To be continued.)

TECHNICAL CHEMISTRY.

On the Use of Petroleum as Steam Fuel, by C. J. Richardson.

As the patentee of the mode for burning petroleum as steam fuel, now being experimented upon at Woolwich Dockyard, permit me to reply to the article by Mr. Paul, which appeared in the Chemical News of December 17 last.

The relative heating powers of petroleum and coal as depending upon their chemical composition is not the question; the ability of each to create steam is the real matter to be considered.

Petroleum as steam fuel can be very nearly fully utilised; it produces no ash, submits to mechanical management, and makes little or no smoke, does not require any strong draught or current of air like coal, which will not burn without it; and the consequence of which is, a very considerable portion of the fuel is lost as waste heat in the chimney.

In a late work by Mr. Wye Williams, one of our chief authorities on this subject, entitled "On the Steam Generating Power of Marine and Locomotive Boilers," he details three careful experiments as to the best form of boiler to obtain the greatest amount of heat from coal. He gives the temperature of the waste heat in the first experiment as 1060°; to the second, 760°; and the third, 635°—and this, be it observed, with the consumption of only 3½ cwt. of coal to each experiment. I should like to learn the temperature of the waste heat in the chimney of a furnace burning from twenty to thirty tons of coal per day. We know the current is so strong that it often carries up small coal and cinders along with it; that the heated gases often take fire by a spark from the furnace, and burn at the top of the funnel with a fierceness almost equalling the flame from a blast furnace. Is this flame or waste heat employed in creating steam? and how much is the coal utilised? In practice the ratio of the heating power of petroleum and coal is about = 1·4 = 0·4. We shall never learn the wicked waste we are making of our coal until petroleum supersedes it.

The American plan can be seen by inspecting the French patent; it was not likely to be successful; it does not follow that other more simple methods may not succeed.

My grate, which burns petroleum through a porous material, has in every instance, when put under a boiler, proved petroleum to be full five times more powerful than coal for steam purposes—one ton doing as much as five tons of coal. If four tons out of five are saved for freight space, the price of the latter being 7*l.* per ton, the profit on every ton of petroleum would be 14*l.* 15s.,—the coal at 15s., the petroleum at 17*l.* per ton.

But a shipowner might not select the American crude at 17*l.*; he would take the Flintshire coal oil, quite as good for his purpose; this is only about 10*l.* per ton.

The average price of coal on a long voyage would be low at 2*l.* per ton. Taking these prices and freights at the reduced sum of 5*l.* per ton in a ship requiring 500 tons of coal, and using instead 100 tons of petroleum, would gain by the exchange 2000*l.* It would not be necessary to start with the full quantity of petroleum, it being more distributed about the earth than coal, obtainable at first cost in the oil countries.

As to the alleged advantage of the oil taking up less room than coal, no notice need be taken of it; a great deal more might be said of the advantage of a ship being able to go from port to port without turning aside for fuel.

Now, as to the highly dangerous, inflammable nature of petroleum, this is in a very great part fudge. If the oil were contained in cast-iron cases securely closed, no vapour could escape; or if the small amount of spirit which produces the inflammable vapour was first extracted, the residue, the burning oil and heavy petroleum, would be no more dangerous than so much lard or spermaceti.

Kensington Square.

Royal Institution.—The following are the arrangements for the ensuing week:—Tuesday and Thursday, January 31 and February 2, at 3 o'clock, Professor Tyndall, F.R.S., "On Electricity." Friday, February 3, at 8 o'clock, Professor Odling, F.R.S., "On Aluminium, Ethide, and Methide." Saturday, February 4, at 3 o'clock, Professor Marshall, F.R.S., "On the Nervous System."

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‡ "Novum Organum," Book 2, Aph. 12.

§ The basis of the physical philosophy of Des Cartes is the hypothesis that all matter consisted originally of square particles, which at the creation were endowed with two motions—the one causing each particle to revolve separately, the other causing groups of particles to revolve around a common centre. The particles during their revolution gradually had their angles worn down by the frequent friction, and thus three elements were produced. The first element, of which the sun, stars, and fire are composed, is the dust produced by the abrasion of the angles; the second, which constitutes the atmosphere, and all the matter between the earth and the stars consists of the spheres which remain when the angles of the original square particles have been worn perfectly smooth; and the third, of which the earth and all terrestrial bodies are composed, consists of the particles which are neither spherical nor square, but which are partly worn smooth and partly have their angles remaining.

The following is the explanation which Des Cartes gives of the production of sparks by the collision of flint and steel:—" . . . consideremus primo varios modos quibus ignis generatur. . . . Nihil usitatius est, quam ut ex silicibus ignis excutiatur; hoc que ex eo fieri existimo, quod silices sint satis duri et rigidi simulque satis friabiles, ex hoc enim quod sint duri et rigidi, si percutiantur ab aliquo corpore etiam duro, spatia quæ multus eorum particulas interjacent, et a globulis secundi elementi solent occupari, solito fiunt angustiora, et ideo isti globuli exsilire coacti, nihil præter solam materiam primi elementi circa illas relinquunt; deinde ex eo quod sint friabiles, simul ac istæ silicum particulæ non amplius ictu premuntur, ab invicem dissiliunt, sicque materiæ primi elementi, quæ sola circa ipsas reperitur, innatantes ignem componunt."—"Principia," Pars quarta, par 84.

PHARMACY, TOXICOLOGY, &c.

On a Test for the Resin of Cannabis Indica, by WILLIAM PROCTER, *jun.*

HAVING accepted the question, "Is there a reliable test for the active resin of Cannabis sativa of the East Indies, whereby the genuineness of 'Extract of Indian Hemp' may be satisfactorily and easily ascertained by the pharmaceutist?" the following paper is offered as a reply:—

It need hardly be said that the extract of Indian hemp is a valuable medicine in the opinion of many practitioners, when prepared from hemp tops that have had their virtues developed by growth in a favourable climate and soil. In East Indian commerce there are three substances derived from the hemp plant—viz., *gunjah*, consisting of the flowers and incipient fruit, with the smaller branches; *bang*, made up of the leaves and capsules without the stalks; and *churrus*, the resinous matter secreted by the hemp plant under favourable circumstances. These have been long known in the East, but the form in which it has been chiefly employed by European and American practitioners is the alcoholic extract of *gunjah*. The variableness in the medicinal power of this extract has been the cause of much disappointment to physicians; for whilst some samples prove effective in half-grain doses, ten or even twenty grains of other specimens have failed to produce its peculiar influence on the nervous system. The extract of commerce varies in consistence and colour. Its green hue is sometimes much darker than at others, and its odour is equally variable in strength. Although professedly an alcoholic extract, much of it is but partially soluble in alcohol of 90 per cent. In a sample of extract, that had been imported several years ago from Mr. Squire, of London, in bulk, as much as 40 per cent. of the preparation was insoluble in stronger alcohol. The undissolved portion was brown, and readily soluble in water. In another sample from the same house in ounce jars, the proportion of aqueous extractive was hardly noticeable. Another sample, the origin of which was not known, and which was quite old, had a solid consistence, almost black colour, and produced powerful effects at the time it was tried therapeutically many years ago. No feature of this extract is more marked than its softness. After a pretty thorough examination of the subject, I believe this to be chiefly due to fixed oil of the hemp seeds, which the tops often contain sufficiently developed to yield oil, and which is, to a greater or less extent, extracted by the spirit, and being miscible with the resin, they remain in close union.

As regards the extractive matter soluble in water, its presence is easily accounted for, either by the use of alcohol weaker than ·835, or by following strong alcohol with weaker spirit to displace the former, when the process is carried too far. When officinal alcohol alone is used, it may occur by continuing the boiling process until the percentage of alcohol gets below the standard strength, as will occur with officinal alcohol during continued digestion. Where the proportion of matter insoluble in alcohol is as great as 40 per cent., either error or design must have produced it, as under no ordinary circumstances will hemp yield to alcohol such a product.

In the process of Mr. Robertson, of Calcutta, described by Pereira, in which the vapour of alcohol boiling in a still is conducted into the top of a cask containing the gunjah, with an ordinary condensing worm attached to the bottom of the cask, this may also readily occur; as the last portions of vapour from the still will be much more watery than the first, they will dissolve the extractive and carry it down into the recipient along with the resin, to be mingled with it in the subsequent concentration to the extractive consistence.

M. Gastinel, of Cairo, Egypt, has suggested that the resin should be washed with water to get rid of this extractive.

M. Laneau, of Brussels, after finding that hemp resin is much more soluble in a mixture of alcohol and ether or chloroform than in alcohol alone, recommends the hemp to be exhausted by percolation with such a mixture, which not only dissolves the resin better, but does not dissolve the inert matter.

Messrs. T. and H. Smith, of Edinburgh, who have studied hemp resin closely, have preferred to treat the gunjah first with water, and then with solution of carbonate of soda, to remove inert matter soluble in these menstrua, after which the hemp is dried and exhausted with alcohol. The tincture is then treated with milk of lime and filtered, and the dissolved lime separated by sulphuric acid. The treatment by lime is probably intended to remove fixed oils, and any other resinous matter than the active one, should any be present. The tincture is then decolorised by passing it through animal charcoal, evaporated to a syrupy consistence, and precipitated by water and dried. This process produces the pure hemp resin, but is far too tedious to pursue with the extract, which, if wholly soluble in alcohol of 90 per cent., is sufficiently freed from the inert matter of the gunjah. To obtain the answer to the query, it became necessary to secure an authentic specimen of hemp extract, which was obtained directly from gunjah of good quality.

1000 grains of gunjah were reduced to powder, with the exception of the stalks, moistened with half-an-ounce of alcohol pressed in a funnel, the stalks thrown on the top, and the whole slowly percolated with alcohol of ·817 sp. gr. until eight fluid ounces of the tincture had passed; the process was then stopped, and the tincture reduced to an extract by careful evaporation.

The product was soft, of a dark, dull green colour, had the peculiar odour of hemp resin well marked, and weighed 110 grains, equal to 9 per cent.

It had the following properties:—

Soluble without appreciable residue in strong alcohol, ether, and chloroform. Benzole dissolved all but a small residue of blackish green matter, which is wholly soluble in alcohol; and on the evaporation of the benzolic solution, the residue retained its odour and other sensible properties.

Oil of turpentine dissolved it quite readily, and the solution, on standing, became coated with minute scaly crystals, the nature of which was not determined.

Olive oil dissolved it completely, forming a greenish solution, which has been suggested for pharmaceutical use by Laneau and Githens.

Sulphuric acid acts slowly on the resin in the cold, more rapidly hot, without intumescence, and when diluted with water, a greyish precipitate falls.

Nitric acid, sp. gr. 1·38, when cold, slowly attacks the extract, but when heated, rapid reaction occurs, red fumes are evolved, and the resin is converted into an orange-red resinoid substance, about as abundant as the resin treated. This, when washed with water and dried, has the appearance of minute fragments of gamboge, which it closely resembles in colour.

This substance is readily soluble in alcohol, ether, and chloroform, and does not crystallise from these solutions on evaporation; it is also soluble in solutions of potassa and ammonia and methylic alcohol, but is insoluble in benzole and acetic acid, and appears to possess an acid reaction with litmus.

Liquor potassæ acts but slightly on this extract, apparently removing little besides matter soluble in water, and, perhaps, fatty oil when present, and a part of the green colouring matter.

Of these reactions those best calculated to indicate true hemp resin extract, are:—

1st. Its odour when moderately treated.

2nd. Its indifference to alkalies.

3rd. Its solubility in alcohol, ether, chloroform, benzole, and turpentine; and

4th. The reaction of nitric acid, which is the best marked test.

Before trying other resins it was deemed best to procure some American grown hemp, and make an extract from it with the same menstruum. Fortunately, this was easily accomplished, and the tops only of vigorous specimens of the cannabis were selected, dried, and powdered. The colour was deep grass green, the odour rank, but different from gunjah. 300 grains were reduced to powder, and treated with the same alcohol in like proportion as in the preceding experiment, and a soft extract, weighing 37 grains, was obtained.

The colour of this extract was a brighter green, and its odour quite different from the extract of gunjah; it rubbed down readily with liquor potassæ, making a dark coloured liquid, not all in solution. When treated with hot nitric acid, rapid effervescence of nitric oxide followed, leaving a yellowish liquid with a very small proportion of orange-coloured resinoid matter, which appeared to be the same as that from Indian hemp.

It is very clear from these results that the extract of common hemp may be easily detected by its solubility in caustic alkali, and the small portion of resinoid it yields by nitric acid.

1. The extract of Indian hemp before alluded to as being 60 per cent. of resin, was tried by these tests, and the resinuous matter found to correspond with that made from gunjah.

2. Squire's extract in ounce jars afforded a large proportion of resin, which reacted with nitric acid like that obtained from gunjah.

3. A sample from my cabinet, fifteen years old, nearly dry, in dark-greenish black masses. This, when acted on by nitric acid, did not lose its greenish colour, and altogether behaved differently from that made from gunjah.

4. Guaiac resin, treated with nitric acid, first became blue,—afterwards yellowish brown, but yielded no yellow resinoid.

5. Common resin yielded a yellowish resinous product by nitric acid, but entirely different from that obtained from hemp resin: in fact, none of the resins tried have afforded a product similar to that from Indian hemp.

Whatever merit there may be in this test, it must be made more manifest by further experiments, with a series of extracts of known origin and therapeutic powers, so that it may be seen whether the results of testing are parallel with medicinal power; and the attention of members is invited to the subject, that they may, from samples tried by the physicians of their several neighbourhoods, apply these tests, and ascertain their real value or accuracy.—From *Proc. Amer. Pharm. Assoc.*, 1864.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, January 19.

Professor W. A. Miller, M.D., F.R.S., *Vice-President, in the Chair.*

After the usual business of reading the Minutes and announcing the several donations to the Society's library, the following gentlemen were formally admitted as Fellows, viz.:—Mr. Alexander Y. Stewart, Mr. Thomas Jones, and Mr. J. F. Payne. The name of Mr. John Reid, Trinity College, Cambridge, was read for the first time, and those of the following candidates for the second time, viz.:—Mr. Thomas P. Blunt, B.A., Shrewsbury; Mr. Robert McDonald Bosanquet, Oxford; Mr. Nathaniel Bradley, Prescot; Mr. Charles Eastcourt, Manchester; Mr. Richard Percival, University of Glasgow; Mr. Arthur Smith, Brixton; Mr. Francis Walker, Sidney College, Cambridge; Mr. Thomas H. Windham; and Mr. Arthur Vacher, London. The certificates in favour of Mr. Alfred Noble, Bristol, and Mr. Joseph Carter Bell, Manchester, were read for the third time, and these gentlemen were balloted for and duly elected Fellows of the Society.

The Chairman said it was proposed to read one or two short papers before proceeding with the adjourned discussion upon Professor Williamson's communication.

Mr. G. B. Buckton then gave a concise verbal statement with respect to a specimen of *Boussingaultite* which he exhibited. It was met with in the neighbourhood of the Soffioni of Tuscany, and consisted to the extent of eighty per cent. of sulphate of ammonia.[*] Its formation had lately been accomplished artificially by passing a mixture of sulphuretted hydrogen, air, and steam through a heated earthenware tube, when the first named gas became decomposed, the sulphur undergoing oxidation, whilst the nascent hydrogen combines with nitrogen to form ammonia.

Mr. W. H. Perkin gave a short account of "*The Artificial Formation of Pyridine*," in which he stated that he had obtained this base amongst the products of the action of nascent hydrogen on azodinaphthyldiamine. He stated that pyridine also appeared to be produced by the action of the same reagent on nitro- and dinitronaphthaline. A nitryl base, probably picoline, he found to be formed by a similar reaction with nitro- and dinitrobenzol.

Mr. C. Greville Williams said that this observation of Mr. Perkin had for him the greatest interest. It was the first time that quantitative proof had been obtained of the formation of any member of the group, excepting by processes of destructive distillation. He regretted that Dr. Anderson was not present, as he should like to have known whether the bi-pyridine obtained by him by acting with sodium upon pyridine had any relation, save that of isomerism, with the base having twice the formula of pyridine formed by Mr. Perkin simultaneously with pyridine, by the action of nascent hydrogen upon azodinaphthyldiamine. He also believed, from Mr. Perkin's description, that the pyridine formed artificially by him was identical with that found in Dippel's oil, and was therefore essentially different from the base having the same formula existing among the products of the decomposition of cinchonine by potash. Mr. Williams also stated that about two years ago he found that by cohobating aniline with sodium for a very long time traces of a nitryl base, apparently picoline, were formed, accompanied by a substance which, by contact with hydrate of potassium acquired a brilliant green colour.

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[*] This natural product appears to be described by Dana (*vide* "System of Mineralogy," fourth edition, Vol. II., p. 379,) under the name of *Mascagnine*, in honour of its discoverer, Professor Mascagni. Its composition is there represented by the formula NH_4O,SO_3+2HO.

The Secretary then read a paper, entitled "*Laboratory Memoranda*," by Mr. Robert Warington, jun., of Cirencester. The first part is devoted to an examination of the action of ferricyanide of potassium upon ferric salts, from which the author concludes that the colour (brown or green) produced on mixing these solutions is essentially dependent upon the ratio subsisting between the two salts which are thus brought into contact. If the iron is in excess a bright green colour is formed. The experiments tended to show also that the liquid remains *clear* only in the event of much free acid being present, and that *basic* ferric salts furnish at once a pale brown precipitate with ferricyanide of potassium. The second part of the author's communication is devoted to the influence exerted by alkaline salts upon the solubility of magnesia and its compounds. It has been found that the chlorides and sulphates of potassium and sodium interfere with the complete precipitation of magnesia by a caustic alkali—an effect attributed to the formation of double salts in a similar manner to that observed in the retardation of magnesium precipitates by the presence of ammoniacal salts.

Mr. Newlands made an objection to the author's statement regarding the action of *basic* ferric salts upon ferricyanide of potassium. It was well known that the excess of ferric oxide existed in these compounds in a colloidal condition, and very trivial circumstances were often sufficient to determine its separation; thus the mere addition of neutral sodium salts, and even acids, occasioned a precipitate, and it was possible that the ferricyanide enjoyed this property in common with other potassium salts. The speaker had lately been in the habit of using the basic ferric chloride or acetate as a reagent for the detection of impurities in distilled water; they were very efficient, since almost any extraneous matter would determine the formation of a precipitate, whilst pure water should remain clear for a long time after such addition.

The Chairman then invited Professor Williamson to make any further remarks upon the subject of "*Chemical Nomenclature and Notation*," which he might wish to offer before the members proceeded to discuss the points raised in his interesting communication presented at the last meeting.

In answer to this invitation, Professor Williamson reminded the Society that he desired more particularly the universal adoption of the system of naming compounds and salts according to the method followed in Gmelin's "Handbook." Thus, ferric chloride, ferrous sulphate, mercuric oxide, mercurous chloride, &c., would convey to the chemist's mind the clearest possible information regarding these compounds of iron and mercury, and by its use it would be impossible to mistake calomel for corrosive sublimate. Questions might arise in regard to zinc and other metals which formed but one basic oxide; in these cases he would not use any prefix to the name of the metal, but speak simply of "zinc chloride;" but if it were desirable to support an analogy—as, for example, in the case of alumina, with other sesquioxides—he would use the requisite prefix, even though the metal were incapable of forming another oxide. Thus, "aluminic chloride" was a better expression than "aluminium chloride." For double salts this method offered great advantages, and for basic oxides even greater facilities for viewing them, on the original type. The speaker doubted whether it would be possible to find a more concise expression for the basic nitrate of bismuth, commonly so-called, (the old *magisterium bismuthi)* than the formula—

$$\mathrm{Bi}\quad\begin{matrix}\mathrm{NO_3}\\ \mathrm{HO}\\ \mathrm{HO};\end{matrix}$$

and its constitution would become at once intelligible by calling it "bismuthic dihydronitrate." Also, when a variety of bases are included in one compound, as in microcosmic salt, the "hydrammonio-sodic phosphate." The term "basic" should be reserved for bodies that contained more than one atom of the basylous constituent in one molecule. Thus, plumbic oxychloride, Pb_3Cl_2O, is a basic salt. With respect to the use of the term "acid," the speaker regretted to notice that his remarks on this head had been, to a certain extent, misinterpreted; at least, he judged so from the tenor of the observations which fell from his friends on the last occasion. It was to him a matter of minor importance whether he was legally entitled to the use of the word "acid" in the sense then advocated, and as being applicable to bodies that do not contain water; and he would impress upon his hearers the advantage of using the term "hydrogen salts" instead of "hydrated acids," particularly in the instruction of beginners; for by this means double decompositions could be explained very simply, and there would be no confusion in the formulæ arising from the conversion of acids into salts. It would be obvious that a scientific system of nomenclature was not suited for ordinary commercial use, and it would be hopeless to attempt to change the designation of such articles as manganese, arsenic, potash, and soda, where the names of the metals are themselves applied to certain oxides, and the alkali made to stand for its carbonate. This consideration need not deter him from recommending the use of the prefices "ous" and "ic" for bases, as they have been long used for acids, and from offering the various suggestions, which he hoped would be freely discussed.

Dr. Debus agreed with the President in the opinion that the appointment of a committee for the discussion of nomenclature would not be attended with any beneficial results. He considered the expression of individual opinion very desirable, and rose, therefore, to ask for explanations upon one or two points. Words are but the signs of conception and operation, and the name conferred upon a body must depend upon our conception of its constitution; and, though this might be liable to change with the progress of intellect and research, it was, nevertheless, incumbent upon us to use now that which is believed to be the correct expression. Quoting from Professor Williamson's published discourse, Dr. Debus wrote upon the board, among other formulæ, the following:—

$$HNO_3.\quad Fe_2(SO_4)_3.\quad K_2Cr_2O_7.$$

The first of these implied that the hydrogen stood in connection with the highly oxidised body, NO_3; and the last presented an inconsistency, for if

$$K_2Cr_2O_7 = K_2(CrO_4),CrO_3.$$

or, in words, the potassic dichromate contained the elements of chromic acid superadded to those of potassic chromate, then the two halves are not of equal value, and the metal chromium is partly united with three, and partly with four of oxygen.

Professor Williamson at once explained that the formulæ were not used by him as denoting any arrangement of the atoms whatever; he simply grouped them in the most concise possible manner. It might sometimes be convenient to write the formulæ of the hydric and potassic nitrates thus:—

$$\left.\begin{matrix}NO_2\\ H\end{matrix}\right\}O \text{ or } \left.\begin{matrix}NO_2\\ K\end{matrix}\right\}O$$

and he would adopt such a course whenever the circumstances seemed to require it.

Dr. Frankland thought the suggestion of Dr. Debus quite worthy of being followed, but such a name would be evanescent from the fact of our views being constantly liable to change. For his own part, he considered it necessary to have two systems: one to individualise the bodies, and the other to carry out Sir Benjamin Brodie's idea of indicating the formula. It must also be evident that a different sign would be required in the case of certain elements to express their differences in energy; thus at present C represents the carbon either in carbonic acid or carburetted hydrogen, but there was no similarity in the two cases, so great was the difference in chemical energy.

Dr. **Odling** considered that the extreme plasticity of Professor Williamson's formulæ was their greatest recommendation, but, on the other hand, he complained that bodies which are not analogous are represented by names which are analogous. Although he would not yet promise to strike out of his vocabulary the little word "of," it was clearly used at the present time by chemists in a signification different from that attaching to it in common parlance. As an example, he might mention the "oxide of chlorine," or the "chloride of oxygen," which are interchangeable expressions in chemistry, but on applying the same test to ordinary forms of language the most ridiculous consequences follow. In his own lectures he commonly adapted two modes of expression; thus he would begin by informing his audience that hydrochloric acid was prepared by the action of sulphuric acid (oil of vitriol) upon "common salt," and then proceed to show upon the black-board the double decomposition which ensued, resulting in the conversion of the "chloride of sodium" into "chloride of hydrogen," &c. Dr. Odling further remarked upon the application of Prof. Williamson's system to the formulating of the calcic phosphates and bismuthic oxychlorides, and maintained that Gerhardt, far from perverting, had the credit of restoring the word "acid" to its original purpose.

Professor **Williamson** here admitted a clerical error which had occurred at page 430 of the Society's Journal for December, 1864, in which he had represented incorrectly the formula of the "calcic di-phosphate."

Dr. A. W. **Hofmann** said that one of the features which recommended the names adopted by Professor Williamson was that they involved comparatively little theory. In the case of the ordinary phosphates of *divalent* metals, like calcium, for instance, it was a matter of doubt whether the salt standing midway between those which contain the smallest and the largest amount of metal should be expressed by the formula—

$$\left.\begin{matrix}\mathrm{Ca''}\\ \mathrm{H}\end{matrix}\right\}\mathrm{PO_4}, \text{ or } \left.\begin{matrix}\mathrm{Ca''}\\ \mathrm{Ca''}\\ \mathrm{H_2}\end{matrix}\right\}(\mathrm{PO_4})_2,$$

the former being the simplest atomic expression by which the salt could be represented, the latter formula indicating more conspicuously the intermediate position of this salt between the two other phosphates—

$$\left.\begin{matrix}\mathrm{Ca''}\\ \mathrm{H_2}\\ \mathrm{H_2}\end{matrix}\right\}(\mathrm{PO_4})_2 \text{ and } \left.\begin{matrix}\mathrm{Ca''}\\ \mathrm{Ca''}\\ \mathrm{Ca''}\end{matrix}\right\}(\mathrm{PO_4})_2.$$

He certainly preferred names which, like those of Professor Williamson, took no notice of theoretical questions of this kind. The speaker had also repeatedly tried his hand at framing names; and no one would accuse him of having neglected the pictorial representation of the composition of bodies in the names which he had given. He must, however, admit that the time had arrived when individual compounds began to lose a great deal of their former interest. The very accumulation of individual compounds compelled them to look to classes; and what appeared pre-eminently necessary were the appropriate names for classes. In many cases such names as "primary," "secondary," and "tertiary monamines" which he had recently proposed for the ammonias of different degrees of substitution, were really, in most cases, quite sufficient, and might frequently, and with advantage, be substituted for the longer names exhibiting the materials of which the building was constructed. This kind of nomenclature was also applicable to the salts of acids; and such terms as the primary and secondary salts of sulphuric acid, the primary, secondary, and tertiary salts of phosphoric acid, conveyed to the student, he could affirm from experience, a clear and precise idea of the nature of the compounds which they were intended to represent.

Mr. **Newlands** pointed out an error which had lately resulted from the improper use of the termination "ine." He found kakodyl described under the name of "dimethylarsine," which term implied that this body was formed on the ammonia type by the substitution of two atoms of methyl for two of hydrogen, and metallic arsenic in place of nitrogen. The body did not, however, contain any hydrogen apart from that which entered into the constitution of the radical, methyl.

At this stage of the discussion, the **Secretary** read a short communication from Mr. G. C. Foster, B.A., entitled, "*On Chemical Nomenclature, and particularly on the Use of the Words Acid and Anhydride.*" The author commences with some excellent remarks upon the requirements of a scientific nomenclature, and insists upon the necessity of having a convenient general language to serve as a medium for all the ordinary purposes of the science; and in the second place, there must be a strictly defined "legal language of the science" which must keep pace with the progress of scientific opinion, and consequently be subject to alteration and reform. The author proceeds then to trace the history of the words "acid" and "anhydride." With regard to the first, it appears that "until the latter part of the last century the substances known as acids were regarded as members of the general class of *salts*, which was commonly divided into *salia acida*, *salia alcalina*, and *salia media vel composita*." Lavoisier then discovered the presence of oxygen in several of the best known acids, and concluded that they were a particular class of oxides. Later research pointed out the differences between these ordinary hydrated acids and bodies, which were obtained from them by the abstraction of water; and ultimately Laurent and Gerhardt limited the application of the term *acid* to salts of hydrogen, such as H_2SO_4, and called the bodies actually or conceivably produced from them by loss of water, such as SO_3, *anhydrides*. The author defends the justice of this course as the only alternative open to MM. Laurent and Gerhardt at that time, for whenever acids were spoken of it happened, in the great majority of cases, that the hydrogen salts, and not the anhydrous acids, were referred to; and the adoption of any other name for this class of compounds would have been attended with great inconvenience. After the lapse of twenty years the reasons which necessitated the use of the terms "acid" and "anhydride" no longer hold good, and the author considered that they might now be amended with advantage; for in his opinion the employment of the word "*acid*" could be altogether dispensed with, and the bodies usually indicated by this term be called "hydrogen salts," particularising the individual compounds as hydric sulphate, hydric chloride, &c.; and likewise the continued use of the term "anhydride" is objectionable, since it merely asserted the fact that a given substance is *not* one of a great variety of things which it might have been, whilst the name does not point definitely to what it really *is*. This latter class the author prefers to describe simply as *oxides*; thus, we should speak of sulphurous oxide, sulphuric oxide, phosphoric oxide, acetic oxide, &c. To such a course there can be only a minor objection, as pointed out by Mr. Watts, to the effect that the terms *carbonic oxide* and *nitric oxide* are already engaged for other compounds; but the same gentleman has suggested the remedy, which consists in resorting to a more specific designation for the oxides in question: thus, CO might still be called "carbonic oxide," and CO_2 "carbonic dioxide," and so, in like manner, N_2O_5 and P_2O_5 would be termed respectively "nitric pentoxide" and "phosphoric pentoxide." The author concludes by expressing his opinion in favour of the entire withdrawal of the terms acid and anhydride, and is convinced that the language of chemical science would be benefited by the substitution of "hydrogen salts" for acids, and "oxides" for anhydrides.

Dr. W. A. **Miller** coincided in Professor Williamson's opinion that the adoption of the modes of expression indicated by the ferric and ferrous salts, &c., would be attended with advantage; and he considered the use of the new word "anhydride" very objectionable, inasmuch as it constituted a kind of negative statement, and was not descriptive of the properties of the compound or group thus designated. He would suggest the adoption of the word "oxyl" in its place, and speak of carbonic oxyl, nitric oxyl, &c. It was desirable, perhaps, once more to examine into the applicability of the old terms invented by the late Professor Daniell for the purpose of expressing the electro-negative radical or group which became separated at the positive pole during the electrolysis of a soluble salt. It would be remembered that the names phosphion, sulphion, and nitrion were respectively applied to the hypothetical bodies known by the formulæ—PO_4, SO_4, NO_3; and by an extension of the same principle, Dr. Miller advocated the employment of "sulphosion" for SO_3, "nitrosion" for NO_2, "oxalion," &c.

Dr. A. W. **Hofmann** said, in connexion with what had fallen from Dr. Miller, that he also had often felt the want of proper terms for this chlorous group, SO_4, PO_4, NO_3, CO_3, &c.; in addition there was no generally recognised name embracing these atomic groups as a class. He had lately found a happy designation for these groups in a posthumous work of Charles Mansfield, whose early death had been a great loss to chemical science in this country. In the work to which he alluded, and which would shortly be published by Mr. Maskelyne, Charles Mansfield had intended the use in chemistry of terms originally borrowed from architecture, and exactly as the architect speaks of the *base* and the *style* of a column, Mansfield speaks of the *base* and the *style* of a salt, designating by the term *style* the chlorous groups of saline bodies as a class.

Professor **Liveing** suggested for anhydrides a designation analogous to that which has been so long employed in an excellent and well-established example of the class—viz., "silica;" we should then have "nitrosica" and "sulphurica" among a series of names having a like termination.

Professor **Williamson** replied briefly to some of the objections raised in discussion, and agreed in the necessity for finding a name which should represent the chlorous radical in salts; in the course of a conversation with Dr. Miller upon the subject, it seemed advisable to call $K_2(SO_4)$ "potassic sulphode," and the salt containing the inferior oxide, $K_2(SO_3)$, "potassic sulphiode." With regard to the appellation of the so-called hydrated acids, all difficulties would cease in the event of their being described as hydrogen salts.

After a vote of thanks being warmly accorded to Professor Williamson,

The **Chairman** stated that, upon the invitation of Dr. Hofmann, it had been decided to hold the next meeting of the Society in the lecture theatre of the Royal College of Chemistry, and upon that occasion Dr. Hofmann had kindly offered to address them upon the subject of "*Lecture Illustrations.*" There were other papers in hand which would be read at the first opportunity, and the meeting was then adjourned until Thursday, February 2, at the usual hour.

ACADEMY OF SCIENCES.

January 16, 1865.

M. **Faye** read the first part of a most interesting memoir "*On the Physical Constitution of the Sun.*" In this part he reviews the opinions of Dr. Wilson and the two Herschels; in the second part he states that he shall notice the principal results of modern observations, and endeavour to co-ordinate them, starting with the idea of a progressive cooling of an enormous mass in rotation, the excessive temperature of which keeps all the elements in the chaos of complete dissociation, save and except at the limit which separates the mass from the void and cold of the celestial spaces. We shall look for this part with great interest, and give our readers a full account of the author's theory.

In the form of a reply to the question *Do the leaves of plants exhale carbonic oxide?* M. Corenwinder describes a simple form of apparatus by which he has been able to prove—

1. That there is no carbonic oxide or other combustible gas in the atmosphere.
2. That dung or manures putrifying in the air give off none.
3. That none is given off by flowers, odoriferous or not.
4. That the leaves of plants never, by day or night, in sunlight or in shade, evolve any. And,
5. That when a plant is exposed to the sun in the presence of carbonic acid, this acid is rapidly absorbed, but no trace of carbonic oxide is expired.

The apparatus is simple enough. The author first draws the air, by means of an aspirator, through caustic potash, to remove all carbonic acid, and then through a tube heated to dull redness, and containing pumice stone and oxide of copper; lastly, the air is made to pass through caustic baryta, to arrest the carbonic acid which may be furnished by carbonic oxide or any other combustible gas.

In a paper "*On the Affinity of Caseine for Acids, and the Compounds which Result,*" MM. Millon and Commaille affirm that when caseine is precipitated from milk by an acid, it forms with that acid a definite compound—*e.g.*, hydrochlorate of caseine $C_{108}H_{97}N_{14}O_{29}HCl$. And so on.

There are one or two other interesting points in the paper which we reserve, merely noticing now the asserted existence of two kinds of caseine in milk—one in suspension with the cream, the other in solution. We may add, too, the authors' belief that caseine is an amide of tyrosine and leucine, the reasons for which belief will appear in the paper.

M. Moncel made a communication "*On the Electro-Magnetic Effects Produced by Uncovered Wire Considered in Relation to the Battery.*" On experimenting with a machine on the principle of M. Carlier, noticed last week, the author finds that quantity currents produced the greatest effects when uncovered wires are employed, and that the effects are much stronger when the bobbins are not too well insulated; and further, that the battery surface must be in proportion to the number of spirals, in order to produce the most marked effects.

In a paper "*On the Spontaneous Alteration of Gun-cotton,*" M. C. Blondeau states that, in the first place, the cotton parts with some of the nitric acid, and is changed into nitrated cotton, still filamentous, but not explosive, showing no trace of an organic acid. The next stage is a change into a gummy mass, which is composed of xyloidine and oxalhydric acid. This transformation is accompanied by the evolution of binoxide of nitrogen. After this the gun-cotton undergoes several modifications, culminating in the production of glucose and oxalic acid. The foregoing changes took place slowly in the dark, but in diffused light they took place more quickly. In direct sunlight the modifications are somewhat different. The mass soon becomes a deep yellow colour, and is then soluble in water. The aqueous solution heated with potash evolves ammonia, which, the author believes, exists in combination with a portion of undecomposed cotton. Of this peculiar compound he intends to give a further account.

Some "*New Facts in the History of Olive Oil,*" by M. Lattier, can hardly be considered novelties. He describes the action of strong and weak chromic acid on the oil, and gives a test founded upon the action of the latter. A solution containing one-eighth of chromic acid should not be opaque after remaining in contact with olive oil for twenty-four hours. A mixture of two parts of the same solution with one part of nitric acid shaken with olive oil should after some days solidify and turn blue, and if it does not, the oil must be considered as adulterated.

NOTICES OF BOOKS.

Report of Experiments on the Growth of Wheat for Twenty Years in Succession on the same Land. By J. B. Lawes, F.R.S., &c., and J. H. Gilbert, Ph.D., F.R.S., &c. London. 1864. Reprinted from the Journal of the Royal Agricultural Society of England.

The green-books of Messrs. Lawes and Gilbert present many of the characteristics of some Government blue-books—that is to say, they contain a mass of valuable facts, which, however, are so presented that it requires some hard digging to get at them. The books may, indeed, be likened to the authors' crops, which consist of grain and straw, both having a value (though widely different), and the grain not to be had without the straw. But, after all, the grain must be thrashed for, and readers may get the important facts from this book by a process of intellectual thrashing and winnowing.

We regard this as unfortunate, considering the class for which the authors write, a class not given to tough reading, and not easily taught. The bucolic mind requires a special method of teaching. No method is, in general, so successful as bold assertion. Farmers will cheerfully buy a mixture of sand and sawdust, or something equally worthless, which is guaranteed to produce eight or nine quarters, but will seldom listen to suggestions for gradually improving their soil, or hear of the necessity for investigations to determine its requirements. Thus, chemists and chemistry are altogether unappreciated by them as a class. Most of them have at some time or other been the victims of a manure quack, who has talked learnedly of phosphates, nitrogen, and ammonia, but has finished by selling them something which never did the smallest good to their land, and thus they have come to mistrust, not altogether groundlessly, all people who use learned terms and promise large results. It is fortunate for them, then, that there are gentlemen who are not only good chemists, but practical farmers, and can show them results, in place of making them promises.

We regard the series of experiments detailed in this book as perhaps the most important that have ever been made on the growth of wheat. As the authors say, "the records of a field of 14 acres in which wheat has been grown without manure, and by different descriptions of manure, for twenty successive seasons, without either fallow or a fallow crop, and in which the lowest produce was in the first year 15 and in the last 17¼ bushels, and the highest in the first year 24½ and in the last 56½ bushels, cannot fail to be of much interest at once to the practical farmer, the economist, and the man of science." The experiments were made on what is called a fair average wheat-land, a somewhat heavy loam, with a subsoil of raw, yellowish-red clay, resting upon chalk, which provides good natural drainage. Now what *the practical farmer*, before all others, wants to know is, how to make such a fair average wheat-land produce 56½ bushels. He will find out if he reads this book with close attention, but we are obliged to say that he might have been told in fewer words, or, in other terms, might have got his grain with less straw. It is to the "concluding observations" that most readers will turn, and to these we resort for the more prominent results of the experiments. We have already quoted the produce of the unmanured land, and also the highest produce of the manured; let us now see the effects of particular manures.

"With farmyard manure, applied every year, the produce was, in the first year, 20⅛ bushels; in the last, [illegible]; and, on the average of twenty years, 32¼ bushels.

"With artificial manures the highest produce was, in the first year, 24½ bushels; in the last, 56½ bushels; and, taking the average of the twenty years, 35¾ bushels, or considerably more than the average produce of Great Britain when wheat is grown in the ordinary course of agriculture in rotation."

The artificial manures here spoken of appear to have consisted of "ammonia salts, *i.e.*, equal parts of sulphate and muriate of ammonia of commerce," and "mixed mineral manure," composed of superphosphate of lime, and sulphates of soda, potash, and magnesia.

With regard to the effect of these manures applied separately we read as follows:—"Mineral manures alone, though applied in the soluble form, increased the produce scarcely at all; that is, they did not enable the plant in any material degree to assimilate more nitrogen and carbon from atmospheric sources than when it is grown on the practically exhausted, unmanured land.

"Nitrogenous manures alone increased the produce very considerably for many years in succession; hence, the soil in its practically exhausted condition was relatively much richer in available mineral constituents than in available nitrogen.

"The largest crops were obtained when mineral and nitrogenous manures were employed together; and it was by such mixtures, even though they supplied no silica (nor carbon), that the produce by farmyard manure was far exceeded, although the latter supplied, not only both silica and carbon, but all other constituents in larger quantity than they were removed by the crops."

A brief record of results obtained upon soils of other description follows, from which we gather that similar treatment in all cases produces like effects. And here, of course, Baron Liebig crops up, who appears in Mr. Lawes' books with the same pertinacity that King Charles did in Mr. Dick's petitions. Now, once and for all, we would recommend Mr. Lawes to let Baron Liebig alone, to steadily pursue the useful course he has marked out for himself, to state plainly and without confusion the practical results of the valuable experiments he undertakes; and some day a philosopher will no doubt give us the true scientific explanation of the facts, while in the meantime flourishing agriculturists and a well-fed people will not be slow to pay the debt of gratitude which will be owing to our author.

We should have liked to say something on the waste of phosphates, on the uses of potash, and on the application of sewage, but space fails us. On the last point, however, we may say that our own ideas are in perfect accordance with those of our author. In conclusion, we must commend this book to the serious study of all our agricultural readers.

Annales de Chemie et de Physique. December, 1864.

We have in this journal the continuation of M. Lamy's memoir "*On Thallic Alcohols*," an abstract of which we have already published. The next is an interesting article by Marshal Vaillant "*On the Horary Variations of the Barometer*," to account for which he offers an ingenious, and, perhaps, satisfactory theory. The mercurial column ordinarily reaches its maximum of height about 9 to 10 in the morning. From that time it begins to fall, and reaches its minimum about 3 p.m. Remaining still from 3 to 4, it then begins to rise between 4 and 5, and about 9—10 p.m. reaches again its maximum of height. What happens to cause this the Marshal explains by a familiar illustration, which we abstract, only remarking that the sun plays the part of the fire here mentioned. When a fire has been extinguished for some time, the air in a room and in a chimney is almost quiescent. When a fire is lit, the lower portion of air in the chimney becomes heated, and tends to rise; but it has to make its way through the column, which occupies the whole chimney, and consequently set this whole column in movement. The struggle lasts some time; sometimes the hot air, not being able to rise sufficiently fast, returns to the room, and the chimney smokes. As long as the struggle lasts the air in the body of the chimney is compressed. This is the first phase of the diurnal period; it corresponds to the heating of the surface of the earth by the rising sun. A moment arrives when the pressure of the air in the chimney reaches its maximum, which corresponds to the barometrical maximum observed from 9 to 10. The current being established in the chimney, the tension diminishes, and now the fire being kept up, the tension gets lower and lower. This is what happens from 9 or 10 to 3 p.m. Now the fire being allowed to go out, the reverse happens, and at last the air again comes down the chimney. Our readers will no doubt see the force of the illustration.

The next is a very interesting paper by M. Cahours, "*On Isomeric Bodies.*" It would be impossible for us to give a satisfactory account of the author's ideas in the short space we could devote here, so we shall present them in the form of an abstract of this paper.

We have already, in our reports of the Academy of Sciences, given some account of M. Roux's "*Examination of Sea Water,*" of which, however, we have here some further particulars. Eighty-eight samples of water were collected for him, in various latitudes, during a voyage from Bourbon to Bordeaux. The author took the specific gravities and estimated the chlorine and saline contents of all these; and all we need say is, that he found very small differences between them. It appears that the water of the northern has rather a higher density than that of the southern hemisphere; the author's experiments, however, seem not to accord with the statement that the saltness of the water increases with the distance from the coasts.

In the very useful review of foreign chemical works, which now forms part of the *Annales*, the writers are, in point of time, far behind the Chemical News, most of the papers noticed being at least six months old.

Zeitschrift für Analytische Chemie. Edited by Dr. C. R. Fresenius. Second Part. 1864.

This part opens with a short paper by Erdmann "*On the Action of Nitrite of Potash on Nickel Solutions in the Presence of Lime, Baryta, or Strontian.*" A process has been given for the separation of nickel from cobalt based on the reaction of nitrite of potash, which forms a double compound of nitrite of potash and cobalt. Dr. Künzel, however, has found that in the presence of lime, baryta, or strontian, a similar yellow compound of nickel is precipitated, and therefore this method of separating nickel and cobalt is only applicable in solutions free from the alkaline earths.

Dr. E. Dietrich describes an ingenious and, we should say, useful form of "*Apparatus for Gas Analysis.*" The description is accompanied with plates, without which it would be unintelligible.

H. Stöss gives a "*Method of Valuing Commercial Anilin, Benzin, &c.*" It is, of course, a distillation process, and offers nothing remarkable.

A short note, by J. Löwenthal, "*On the Uselessness of Peroxide of Lead in Quantitative Analysis.*" Peroxide of lead has been proposed for estimating nitrous acid, but the author shows that, contrary to the common opinion, peroxide of lead is soluble in dilute acids in the cold.

In a paper "*On the Determination of Lime as Caustic Lime,*" Fritsche recommends that the ignited oxalate should be weighed as caustic lime, and not carbonated; and similarly, a precipitated carbonate, not simply dried, but fully ignited for a quarter of an hour, if the quantity does not exceed one gramme, for half an hour if it does.

Dr. A. Fröhde communicates a process for "*The Analysis of Double Cyanides by Hyposulphite of Baryta.*" The cyanide is well mixed with forty times its weight of the baryta salt, and the mixture fused in a covered porcelain crucible until the metallic and alkaline cyanides are converted into sulphides. The mass is then dissolved in water, and excess of baryta precipitated by a few drops of sulphate of ammonia. The liquor is now filtered, and the metallic sulphides are extracted from the residue on the filter by hydrochloric and nitric acid, and the metals determined by known methods. The filtrate is evaporated with hydrochloric acid to get rid of hydrosulphocyanic acid, and the alkaline sulphates converted into chlorides by chloride of ammonium. Potash, soda, and magnesia can then be separated and determined by known methods. This process is specially applicable to the platino-cyanides.

The same author gives a short "*Contribution to the History of Hyposulphurous Acid,*" showing that a hyposulphite is formed by the action of the air on a polysulphide. He found that sulphide of ammonium, evaporated almost to dryness, the residue dissolved in water, filtered from the separated sulphur, gave all the reactions of an alkaline hyposulphite.

A paper by Dr. F. Stohmann, "*On the Valuation of the Commercial Manures,*" contains nothing of importance to English chemists, except a suggestion for estimating free ammonia which may be lost in determining the moisture in a guano. For this the author dries the guano in a tube, through which he draws, by means of an aspirator, a current of dry air, which is made to pass through bulbs containing a standard acid, by which the ammonia is arrested, and can be determined in the usual way. Every chemist will see the arrangement necessary for this.

A communication, "*On the Detection of Arsenic in Antimonial and other Chemical Preparations,*" by J. M. Scherer, calls for no notice. Fresenius, in a short paper, gives the *Solubility of Arseniate of Ammonia and Magnesia* in pure water and water containing free ammonia, or chloride of ammonium, or both. The solubility is slight, but must be taken into account when arsenic acid is determined in that form. One part of the anhydrous salt dissolves in 2788 parts of pure water, in 15,786 parts of water containing ammonia (1 liq. ammon. to 3 of water), in 1380 parts of dilute solution of sal ammoniac, in 886 parts of strong solution of sal ammoniac, and in 3014 parts of a mixed solution of ammonia and sal ammoniac.

Fresenius also notices Lensenn's "*Volumetric Method for Estimating Manganese by the Reduction of Ferridcyanide of Potassium.*" This method is given in the last edition of the writer's quantitative analysis, and now having tried it the author states that although the results are not strictly accurate, yet they come sufficiently near for ordinary purposes.

The remainder of the journal consists of extracts from other periodicals, in many of which we have anticipated it, but we shall give some from periodicals which do not reach us.

The Year-book of Pharmacy: a Practical Summary of Researches in Pharmacy, Materia Medica, and Pharmaceutical Chemistry during the year 1864. Edited by C. H. Wood, F.C.S., and C. Sharp. London. 1865.

We have, on many occasions, complained of the absence in this country of some of those useful annual publications which bring together the scientific discoveries of a past year in a form which makes them easily accessible to readers who have but little time or opportunity to search for them in more extended works. The medical profession supports two such periodicals, and it will be strange indeed if the pharmaceutical profession does not appreciate the attempt of the editors of this book to supply a want which every pharmaceutist must have felt. "The Year-book of Pharmacy" will, no doubt, find its place on the desk of every chemist and druggist, who will find it to supply them, in a concise form, with all the most useful facts relating to pharmacy which have been published during the past year. We heartily wish the editors the success they deserve.

NOTICES OF PATENTS.

1203. *Treating Canvas, Tarpaulings, or other Painted Canvas, to Render them Suitable for Household Purposes.* W. Horne, West Ham. Dated May 12, 1864.

This is an ingenious method of treating waste material in the form of old oil cloth, &c., by extracting on the one hand the resins and pigments, and saving the fabric for renewed employment. The waste pieces of painted canvas or tarpauling are immersed for six hours in an aqueous solution of oxalic acid, containing one pound of the crystals to 100 gallons of water. They are next treated with a strong solution of American potash, about 15 lbs. weight to 100 gallons; then with sesquicarbonate of ammonia solution of the same strength. The articles are then washed with warm water, and subjected to hydraulic or other pressure, which facilitates the removal both of salts and pigments; and, if necessary, the cloths are then further treated with pearlash, or other alkaline solution, and finally washed with cold water.

1218. *Manufacture of Card Cloth and other Waterproof Fabrics.* A. Bateman, Low Moor, near Bradford. Dated May 13, 1864.

The inventor prepares a fabric, which is both oil and water-proof, by uniting two thicknesses of calico, linen, woollen cloth, or leather, by means of an elastic compound varnish composed of—

Gutta percha	55 parts.
India rubber	10 „
Gum lac	5 „
Bisulphide of carbon . .	20 „
Cinnabar	5 „
Plumbago	5 „

1254. *Bottles or Vessels for containing Poisons.* J. B. Merrikin, Bath. Dated May 18, 1864.

The patentee claims the use of bottles or vessels made by casting or moulding, and having protuberances or projecting portions upon their external surfaces, so that the sense of feeling may aid that of vision, and furnish a twofold indication of the dangerous nature of their contents.

1258. *Manufacture of Zinc.* J. Webster, Birmingham. Dated May 18, 1864.

This invention relates a new mode of reducing zinc from its ores, and of determining the volatilisation of the separated metal. The zinc ores are to be roasted, and the oxide of zinc so formed is brought into contact with molten iron in a suitable furnace, whereby the iron takes the oxygen, and the zinc is made to sublime, the metallic fumes being afterwards condensed in the usual manner.

The known affinities of iron and zinc, both in the metallic form and as oxides, would, we should suppose, have entailed a loss of metal.

1259. *Improvements Applicable to Street and other Lamps or Lanterns.* J. Browning, Grosvenor Road, Pimlico, London. Dated May 18, 1864.

For the purpose of economising the rays of light which radiate upwards from street lamps, the inventor uses reflectors fixed at such an angle as will have the effect of throwing those rays outwards or downwards.

It is surely time that some available plan of reflecting the top light were discovered and applied. Many experiments have been tried in the street lamps of this metropolis, but years have rolled on without any general scheme being practically adopted.

1262. *Metallic Alloys.* T. Dunlevie, Dublin, and J. Jones, Liverpool. Dated May 18, 1864.

The patentees claim the manufacture and use of alloys containing spelter (zinc), tin, and small quantities of copper and antimony.

The alloys of tin and zinc alone have often been made and described; they are perfectly uniform throughout, of brilliant white colour, hard and durable, and not prone to oxidation; but their cost is even greater than brass, which for most purposes would be preferred on account of its colour.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

3045. E. T. Hughes, Chancery Lane, London. "Improvements in treating aniline colours for dyeing and printing." A communication from A. S. L. Leonhardt, Berlin. Petition recorded Dec. 6, 1864.

3093. C. Hancock, West Street, Smithfield, and S. W. Silver, Bishopsgate Street, London. "Improvements in colour printing."

3102. A. P. Price, Lincoln's Inn Fields, Middlesex. "Improvements in obtaining carbonic acid gas."—Dec. 14, 1864.

3161. S. P. A. de Brocalde d'Elüza, Leicester Square, Middlesex. "A new or improved manufacture of artificial manure."—Dec. 20, 1864.

3184. R. L. Howard, Upper Whitecross Street, Middlesex, and J. Dauglish, M.D., Reading, Berkshire. "Improvements in apparatus for making aërated bread."—Dec. 22, 1864.

3192. J. Bethell, King William Street, London. "Improvements in preserving wood."—Dec. 23, 1864.

3229. J. D. Morrison, Wemyss Place, Edinburgh, N.B. "Improvements in painless dentistry, by apparatus for cooling and tempering air and applying it as an anæsthetic agent."—Dec. 29, 1864.

12. W. G. Helsby, Liverpool, Lancashire. "Improvements in the manufacture of enamelled glass, to render it more useful in photographic art."

16. T. J. Ashton, Cavendish Square, Middlesex. "An improved portable pneumatic apparatus, applicable in surgery and medicine for all purposes, as a douche for affusion, irrigation, injection, and for enemas."—Jan. 3, 1865.

39. T. Pickford, Fenchurch Street, London. "Improvements in preparing and keeping aërated beverages."—Jan. 5, 1865.

47. W. C. Thurgar, Norwich. "A new or improved method of keeping the substance of eggs fresh and sweet."

51. J. Robertson, Glasgow, N.B. "Improvements in furnaces, ashpits, and flues for the consumption of smoke and noxious products of combustion, and in the apparatus or means connected therewith."—Jan. 6, 1865.

79. T. B. Belgrave, M.D., Bracebridge, Lincolnshire. "Improvements in preserving meat."

81. D. Gattafeut, Stepney Causeway, Middlesex, and F. Pontifex, Shoe Lane, London. "Improvements in artificial fuel."—Jan. 10, 1865.

93. A. G. Lock, Millbrook, Hampshire. "Improvements in extracting and purifying fats and other products from bones and other animal substances, and in apparatus for the same."—Jan. 11, 1865.

Notices to Proceed.

2244. J. H. Johnson, Lincoln's Inn Fields, Middlesex. "Improvements in the preparation or treatment of colouring matters obtained from aniline." A communication from H. F. G. de Claubry, Paris, France.—Petition recorded Sept. 14, 1864.

2294. R. A. Brooman, Fleet Street, London. "Improvements in the manufacture of phosphuret of iron, phosphate of lime, and alkaline phosphates." A communication from Edouard Aubertin, Paris, France.—Sept. 19, 1864.

2470. W. Clark, Chancery Lane, Middlesex. "Improvements in preparing or treating vegetable fibrous materials." A communication from Hubert Dupré, Boulevart St. Martin, Paris.—Oct. 7, 1864.

2564. J. Maurice, Langham Place, Middlesex. "Improvements in the means or method of producing optical illusions in theatres or exhibitions."—Oct. 17, 1864.

3062. R. A. Brooman, Fleet Street, London. "Improvements in apparatus for cooling and freezing." A communication from Marcar Beylih'g, Constantinople, Turkey.—Dec. 8, 1864.

3185. J. Gillespie, Garnkirk, Lanarkshire. "An improved construction and manufacture of retorts, crucibles, glasshouse pots, and other similar vessels, and in the means and apparatus employed therein."—Dec. 22, 1864.

3195. R. A. Brooman, Fleet Street, London. "Improvements in coke ovens." A communication from F. J. F. Laumonier, Angers, France.—Dec. 23, 1864.

CORRESPONDENCE.

The Society of Arts and Dr. Hofmann's Report.

To the Editor of the Chemical News.

Sir,—I have read Mr. Le Neve Foster's defence of the Society of Arts, and am by no means satisfied with it. I will illustrate the consequences of the conduct of the Society by my own case. I am not a member of the Society, but I wished to have the Reports of the Exhibition, and, moreover, I was anxious to read them as soon as I could. I therefore purchased them as they appeared of Bell and Daldy, in Fleet Street, the Society's publishers. Naturally enough, I was most anxious to procure the report most interesting to me, that on Section II., Class A., and was, I need not say, disgusted enough on learning that none would be sold separately. It therefore appears that after purchasing of the Society the greater part of the Reports, I cannot buy what I want to complete my set, but must buy the whole series over again in the shape of a fifteen shilling volume. If a similar course had been pursued by any private publisher, the proceeding would be stigmatised as a "do," and I do not see why the same term should not be applied to this transaction of the Society of Arts. I am by no means sorry to learn that the publication of the Reports has ended in a pecuniary loss to the Society, and I shall never think of subscribing to any further publication of the Report by the Society; but I shall willingly put my name down for a republication, with additions, by Dr. Hofmann, which, I believe, would be successful.—I am, &c. A Chemist.

London, January 22.

Japanese Matches.

To the Editor of the Chemical News.

Sir,—On reading Dr. Hofmann's pretty little communication to the Chemical Society (Chemical News, December 24, 1864) upon the "Japanese Matches," I remembered that the prescription for them is given in Pepper's "Playbook of Metals," though without, as far as I can recollect, any reference to the Japanese.

Mr. Pepper gives the following :—

Nitre . . .	4 parts
Sulphur . . .	2 ,,
Lamp-black . .	1·5 ,,

as a composition emitting beautiful rosettes during combustion.

Dr. Hofmann prescribes :—

Nitre . . .	4 parts
Sulphur . . .	1·85 ,,
Wood-charcoal .	1·23 ,,

and the composition is stated to burn with sparks branching out in beautiful dendritic ramifications.

I am sorry that I have not Mr. Pepper's book at hand just now, and cannot refer to the exact page from which I copied the above prescription at least two years ago.

I have always felt a regret that the highly popular style of Mr. Pepper's writings should have caused many interesting experiments to remain unknown to some of our most eminent lecturers, who have consequently been put to the trouble of re-inventing them.

The particular work from which I have quoted contains, as you would expect, a great heap of "chaff" for the juveniles, but older birds may pick out enough corn to repay them for turning it over. I am, &c.

"At Home for the Holidays."

Coal as Food for Pigs!

To the Editor of the Chemical News.

Sir,—My wife has fed her pigs with small coal for a long time. She administers it at the rate of one shovelful per day per animal, with the same regularity that the children get their "black draught." Not only do coals go down with a gusto, but cinders from under the grate are equally relishable. I shall leave the chemistry of the affair to you; but there is no doubt about the efficiency of the specific, especially where piggy is confined, and not allowed the run of the parish, I am, &c.,

G. P.

Ebbw Vale, January 23, 1865.

[We print this note, having no reason to doubt the writer's good faith.]

MISCELLANEOUS.

Chemical Society.—The next meeting of this Society will be held in the Theatre of the Royal College of Chemistry, Oxford Street, W., on Thursday evening next, when Dr. Hofmann will give a discourse "On Lecture Illustrations."

Renard v. Levinstein.—Vice-Chancellor Sir W. P. Wood delivered his judgment in this case on Tuesday last. His Honour found for the plaintiffs on all the issues, thereby declaring Girard's patent valid, and deciding that the defendant's process was an infringement of the patent. We shall give an abstract of the judgment (which occupied two hours in delivery) in our next number.

Eidos Aeides.—Among the many recent applications of optical science to scenic illustrations, no one has been more strikingly effective than that now to be seen at Her Majesty's Theatre under the above title. The instantaneous substitution of one living figure, in all its solid reality, for another equally solid and real—the visible becoming invisible, and the invisible visible—is one of those startling effects which a few generations ago would have caused the inventor to be regarded as having dealings with the black art. So skilfully is the illusion arranged, that an ordinary observer would quite fail to obtain the smallest clue to the method by which it is effected. To one well versed in the modern way of raising ghosts, a few circumstances he might notice would suggest that a sheet of glass and an electric or lime light had something to do with it; but, so perfect is the illusion, and so effective the dramatic situation, that it would be wrong to spoil the delight of witnessing the scene by intruding the means by which the effect is produced. Theatrical criticism is not our vocation, but we may say that our readers will be greatly amused and astonished by the Eidos Aeides, and its accompaniments.

ANSWERS TO CORRESPONDENTS.

Received.—W. Arnott; will appear in our next.

Enquirer.—The so-called "varnish" is composed of beer-finings coloured black.

Juvenis.—Use a little less sulphur, and gunpowder.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

An Introduction to Chemical Philosophy, according to the Modern Theories, by Adolphe Wurtz, *F.R.S.*

Part I.

Equivalents, Atomic Weights and Molecular Weights.

Section I.—*Historical Development of the Ideas, Equivalent, Atom, Molecule.*

(*Continued from page 38.*)

Nearly twenty years passed over before this question of the proportion between the weights of acids (or bases) saturating a definite amount of a base (or an acid) was again taken up. Another German chemist, Richter, of Berlin, drew attention to the subject in a work which he published in 1792 or 1794, entitled *Stœchiometry, or the Art of Measuring the Chemical Elements.*[*] Besides this he published between 1792 and 1802 a periodical work, called *Ueber die Neueren Gegenstände in der Chemie* (Later Discoveries in Chemistry), the seventh, eighth, and ninth numbers of which are especially interesting. The author observed and explained, as did Wenzel, the phenomenon of the permanence of neutrality after the mutual decomposition of neutral salts. He determined the relative saturating capacity of acids and bases. He noticed that when a metal precipitated another metal from a solution of a neutral salt the liquid remained neutral. From this last observation he deduced a very correct explanation by showing that there existed a constant ratio between the amount of an acid saturating given weights of different bases and the quantity of oxygen contained in these bases; or, what comes to the same thing, that the quantity of oxides required to saturate the same weight of a given acid contained the same amount of oxygen.

To Richter we owe the first tables of equivalents. They are drawn up in reference to the reciprocal saturation of acids and bases, and consist of two kinds of tables.

The first shows the weight of different bases which neutralise 1000 parts of an acid—sulphuric acid, for instance.

The second shows the quantity of acids required to neutralise 1000 parts of a base, such as potash or lime.

The figures which compose these tables are derived from analyses which are less exact than those of Wenzel, and which appear to have been corrected, too late, to make them agree with certain theoretical ideas which were more erroneous than the experiments themselves.[†]

For all that, Richter recognised this important fact, that the weights of bases forming the first series were proportional to each other, and that the same proportionately existed between the quantities of acids forming the second series; so that if he knew the quantities of all the bases which neutralised an acid A, it would be sufficient, in order to find the amount of any base which would be required to neutralise another acid A′, to determine by one experiment the weight of any one of the bases necessary to form a neutral salt with this acid A′; knowing the weight of this base, it would be easy to calculate the weight of all the others. Thus Richter showed that the composition of a great number of salts could be reduced theoretically from the known composition of certain other salts—an important deduction from the fact of the proportional relation between acids and bases which had been already established by Wenzel, and which the Berlin chemist saw the force of in all its bearings.

One thing, however, escaped him, and that was that it was useless to multiply the series so much, and that they might all have been founded on one alone. Indeed, after having determined the quantity of different bases required to neutralise 1000 parts of sulphuric acid, it would have been enough instead of determining the quantity of base which would neutralise another acid, to find out how much of the other acids would be required to saturate the weight of any one of the bases neutralising 1000 parts of sulphuric acid. These amounts of acids would be equivalent to 1000 parts of sulphuric acid, and would exactly saturate the weight of base neutralised by 1000 parts of this acid. It is seen from this that Richter need have constructed only one table of equivalents of bases and acids calculated in relation to 1000 parts of sulphuric acid. Fischer calculated a table of this kind from Richter's data, and published it in 1802.[‡] The following is a copy of it:—

Bases.	Fischer's numbers.	Theoretical numbers.
Alumina	523	428
Magnesia	615	500
Ammonia	672	
Lime	793	700
Soda	859	775
Strontia	1329	1295
Potash	1605	1177
Baryta	2222	1912

Acids.	Fischer's numbers.	Theoretical numbers.
Sulphuric	1000	1000
Hydrofluoric	427	500
Carbonic	577	550
Hydrochloric	712	912
Oxalic	755	900
Phosphoric	979	887[§]
Formic	988	925
Succinic	1209	1224
Nitric	1405	1350
Acetic	1480	1275
Citric	1683	1375
Tartaric	1694	1650

It will be noticed that for many bodies Fischer's numbers are widely different from the theoretical figures, and consequently the analyses of Richter from which they are calculated were not nearly so accurate as those of Wenzel. The inaccuracy of these analyses, and the obscurity of a perplexed explanation, have not been much noticed in giving Richter credit and some authority to his works.

One thing, however, remains established: Wenzel and then Richter have introduced into the science the notion of equivalents.

(To be continued.

On the Estimation of Phosphates, and the Detection of Fluorine in Coprolites, by W. Arnot, *Anderson[illegible]n Laboratory, Glasgow.*

About four years ago a paper appeared in one of the

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[*] *Stœchiometrie oder Messkunst Chemischer Elemente*, by Jeremie Benjamin Richter, in three volumes. The word stœchiometry is used in Germany at the present day to designate that branch of the science which treats of the equivalents. Richter died at Berlin in 1807.

[†] Richter imagined that the weights of acid neutralising the same base were in geometrical progression, and that the quantities of base neutralising the same acid were in arithmetical progression.

[‡] Hermann Kopp, *Geschichte der Chemie*, vol. ii, page 364.

[§] This number is half of 1775, which represents the weight of PO_5, if 1000 represents that of SO_3. But it must be noticed that to *neutralise* PO_5, that is to say, to form $2NaO,HO,PO_5$, there must be twice as much soda as is required to neutralise SO_3. The quantity of phosphoric acid strictly equivalent to SO_3 is therefore half PO_5 under the circumstances in which Richter was placed.

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chemical journals, setting forth that tribasic phosphate of lime was soluble in chloride of ammonium. Since then many chemists have, I believe, given the question consideration, and have, no doubt, kept the fact in view in the course of their analyses. The investigations, the results of which are herein detailed, originated in the marked discrepancies in the analysis of a sample of coprolite, as reported by several chemists of eminence, to whom it had been submitted. The amount of phosphates, upon which the value of the article mainly depends, was reported by one at 58 per cent., by another 59, by a third 61, a fourth 62, and by a fifth 64. What could any one, either scientific or commercial, make of such results? Error there must be in at least four, if not in all, of these figures. The discovery of the cause of this error was a task assigned me, and as the results of my investigations appear to be possessed of some practical value, as well as scientific interest, I do not hesitate to lay them before the readers of the Chemical News.

Four of the above estimates were, I have ascertained, obtained by the same process —viz., by direct precipitation with ammonia, and re-solution. Now, although the process is seldom or never recommended in standard works on chemical analyses, and manifestly on account of the solubility of the precipitate in the menstruum, it is nevertheless very frequently practised in the analyses of commercial products.

To what extent $3CaO,PO_5$ is soluble in chloride of ammonium seems to be but little understood. The following results of two sets of experiments will help to show that it is so to a very appreciable extent. In each of five experiments with a sample of coprolites, specially pulverised and mixed for the purpose, conducted simultaneously, and with the same weight of the sample in each, exactly the same treatment was followed till the second precipitate was obtained, the first being re-dissolved as usual. The five precipitates, as nearly alike as careful manipulation could make them, were redissolved respectively with $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, 1, and 2 oz. of HCl, 6 oz. of water being employed in each case. Having re-precipitated, the following were the results obtained:—

With $\frac{1}{8}$ oz. HCl, precipitate gave 57·08 per cent.
,, $\frac{1}{4}$,, ,, 55·83 ,,
,, $\frac{1}{2}$,, ,, 53·33 ,,
,, 1 ,, ,, 49·50 ,,
,, 2 ,, ,, 46·66 ,,

The effect of continued reprecipitation is shown by the following:—15·24 grs. of sample gave first precipitate 65·24 per cent.; the second, 59·90; the third, 56·73; the fourth, 53·85; the fifth, 51·56; and the sixth, 49·83. From these experiments it is very evident that the process of precipitation with ammonia is a faulty one, and sufficiently so, in my estimation, to account for the discrepancies in the results referred to, arising, no doubt, from variable quantities of HCl having been used, and, consequently, of chloride of ammonium.

By some analysts, who rely on extensive washing for the removal of the excess of lime, which is invariably carried down in the first precipitation, the first precipitate is the one reported. By others the second precipitate is the one usually given, while a few go as far as the third precipitate. There are, however, other causes which militate against the process—so far, at least, as its application to coprolites is concerned. The effect of bulk of solution is one of these, and is here shown. The quantity of acid employed in each case was the same, and they were all brought uniformly to the second precipitation.

With 2 oz. solution, precipitate gave 56·83 per cent.
,, 4 ,, ,, 56·83 ,,
,, 6 ,, ,, 56·10 ,,
,, 8 ,, ,, 55·35 ,,
,, 16 ,, ,, 53·25 ,,
,, 24 ,, ,, 50·40 ,,

Increase of bulk is here followed by decrease of precipitate.

The fluoride of calcium in coprolites also affects the accurate determination of the phosphates, when the ordinary precipitation method is employed. It is completely dissolved by the dilute HCl, and is thrown down on the addition of ammonia. In a particular experiment, the phosphates were precipitated from 50 grs., redissolved, precipitated, dried, ignited, and tested for fluorine; unequivocal evidence of its presence was obtained. The insoluble from 100 grs. was next treated for fluorine, but not the slightest trace was detected. Altogether, then, the process seems to be a fallacious one, being neither scientifically correct, nor suitable for commercial valuations.

Several sets of experiments were likewise conducted for the purpose of satisfying myself as to the reliability of the ammonio-phosphate of magnesia method, and with entirely satisfactory results. I simply give the results of one set, premising that in each experiment different bulks of solution and proportions of chloride of ammonium were employed. The following were the percentage quantities obtained:—60·35, 60·25, 60·45, 60.30, 60·35, 60·20. These differences cannot be attributed to faults in process, but are admittedly due to defects in manipulation. No fluorine was discovered in the phosphate of magnesia precipitate.

To the various other methods for the estimation of phosphoric acid, it is not necessary to refer; several of them are quite trustworthy, but they do not admit of application in ordinary commercial analyses. I may, however, offer a remark with reference to the detection of fluorine in this manure. In a popular technical work recently published, it is stated that the presence of fluorine in coprolites may be easily detected in the usual way, as hydrofluoric acid, by the etching power of the gas. Now, the result of experience in this laboratory goes to show that such is not the case. On adding SO_3 to the powdered coprolites HF certainly is formed if fluorine be present, but owing to the presence of silica in the coprolites, it is immediately converted into fluoride of silicon, and is thus disguised from the test referred to. In the state of fluoride of silicon, it may be readily detected by passing the gas through water, or into a tube, the interior of which has been moistened with water.

I may mention in conclusion that the analysis of a phosphate of lime precipitate, after five precipitations, gave proportions of CaO and PO_5 corresponding very closely with $3CaO,PO_5$, which tends strongly to show that the loss by reprecipitation is owing to the solubility of $3CaO,PO_5$ in chloride of ammonium, and not, as is sometimes supposed, to the abstraction of lime alone.

On the Solubility of Sulphate of Lead in Pure Water at 15° C., by George F. Rodwell, *F.C.S.*

Two thin glass flasks, of as nearly the same weight and capacity (620 c.c.) as possible, were thoroughly cleaned with acid, dried, heated in an air-bath to 190° C., and after standing several hours in vacuo over commercial sulphuric acid, were weighed. The first was weighed by substitution, and the weight of the second determined by counterpoising it by the weighed flask, and making up the very slight difference by weights. Into one flask was weighed a quantity (about 500 c.c.) of solution of sulphate of lead in water, and into the other the same quantity of distilled water, similar to that used for the solution of the sulphate, the requisite corrections being made for displaced air, &c. The sulphate had been digested in water at the ordinary temperature for about two months, in a stoppered bottle, and at the same time a similar bottle was filled with distilled water, the amount of each taken for a determination was filtered before weighing, and evaporated to dryness in the flasks, which were then heated, cooled in vacuo, and weighed with the same precautions as before; the traces of residue left by the distilled water being subtracted from that left by the sulphate solution of course gave the absolute quantity of sulphate of lead dissolved by a known amount of water.

Stas has shown that the most carefully distilled water leaves an appreciable residue, and moreover, it is to be imagined that a trace of solid matter would be dissolved from a glass vessel by water which remains for two months within it; I invariably found that 500 c.c. of water left a residue capable of being accurately weighed, and sufficient in quantity to have vitiated the results if left undetermined.

Every precaution was taken to treat the two flasks and their contents in precisely the same manner, the area of the mouth of each was equal, the evaporations were carried on in close proximity to each other, and with as nearly the same amount of heat as possible, and the time of the flasks remaining in vacuo, and that occupied by weighing them, was the same in each determination.

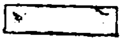
100 parts of water at 15° dissolve of sulphate of lead:

·00323
·00321
·00322
·00296
Mean = ·003155

Hence 1 part of sulphate of lead is soluble in—

31061·8066 parts of pure water at 15°.

When a solution of sulphate of lead in water is evaporated to small bulk, the sulphate is deposited in crystals, which are seen under the microscope by the use of a very high power to be of the following forms:—



When a solution of sulphate of lead in water is treated with sulphuretted hydrogen, it becomes distinctly brown, so much so that an object is perfectly invisible when seen through a column five inches deep, and only becomes visible as a bare outline when the column is reduced to a depth of four and a quarter inches.

TECHNICAL CHEMISTRY.

Contribution on the Manufacture and Refining of Cane Sugar, by Ch. A. Goessmann, *Ph.D., Syracuse, New York.*

(*Continued from page 28.*)

To ascertain the effect of ferment * upon cane sugar after boiling, I proceeded as follows:—I added a large quantity of ferment to a solution of cane sugar of 16°—17° Baumé, at 18°—19° Celsius. Then I raised very rapidly the temperature of the mixture to its boiling point (102° Cels.), and kept it boiling nearly one hour, after which time I carefully separated, by filtration, the solution from the insoluble parts. Trommer's grape sugar test proved that the solution contained a considerable quantity of the latter. Subsequently I divided the solution into equal parts, and put each part into a glass flask of sufficient size. One part, which I will call No. 1, was left unaltered; to the other I added several ounces of carbonate of lime (pulv. chalk). I closed both flasks with corks, containing properly shaped glass tubes, for passing the gas probably evolved in a solution of caustic lime. Both corks were sealed to render them perfectly tight, and I kept the further ends of the tubes almost constantly under lime water. Both experiments were carried on at 20°—22° Cels. during the same duration of time. Their final results were ascertained on the same day. The solution in No. 1 began within a few days to ferment briskly; a small quantity of mould was formed upon the surface of the liquid. The evolution of carbonic acid gas became more and more lively; during the succeeding days the mould disappeared gradually from the surface. After being kept three or four weeks, no further apparent change could be observed; the bottom of the flask was found to be covered with a thin layer of dirty white sediment. This sediment contained a considerable quantity of tricalcic phosphate. Heated by itself, it smelled like burned glue; and mixed with an excess of hydrated caustic lime, it evolved abundantly ammonia gas. I separated the sediment from the liquid by filtration, and subjected the latter to a process of distillation, increasing finally the temperature for some time to 125°—130° Cels. Thus I obtained 105 grms. of an alcoholic distillate, equal to 15° Richter, at 18° Cels., containing a quantity of free acetic acid equal to 0·3965 grms. of acetate of soda. The remaining non-volatile, syrup-like mass was brown, having an acid reaction, tasted sweet, and was easily again brought, by increased ferment, to a rapid fermentation. It contained no cane sugar, no mannite, no lactic acid, and consisted, in its entire mass, of a concentrated solution of grape sugar, with traces of acetic acid. Whether any succinic acid had been produced, as C. Schmidt † and Pasteur have observed among the results of an alcoholic fermentation, I have not taken pains to observe, for it presented no particular interest to the main question with respect to the object I had in view.

The solution No. 2, containing the carbonate of lime, indicated apparently little change during the first two or three days, and then became partly covered with a filmy mould, and evolved large quantities of carbonic acid, even after two weeks' keeping. The evolution of this gas kept on in No. 2 three weeks longer than in No. 1. The carbonate of lime, which, during the first weeks, was partly kept in suspension within the liquid, and thus only loosely covered the bottom of the flask, settled afterward in a compact mass. As soon as no further changes were apparent, I separated the liquid part by filtration, leaving upon the filter the excess of carbonate of lime employed and the crystallised part of the new compounds formed during the period of fermentation. The filtrate subjected to distillation (like No. 1) gave an alcoholic liquid of 110 grms., equal to 7 Richter at 16 Cels., containing free acetic acid, equal to 0·6190 grms. of acetate of soda. The remaining non-volatile

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* On account of the similarity of effects of the ferments from the juice of sugar cane and those from malt, I was induced to select common fresh brewer's yeast for my experiments. This ferment was not washed before being used; it proved in that state very active.

† "Annal. of Liebig and Wöhler." 1863. April No., p. 126.

residue of the filtrate formed, after cooling, a solid crystalline mass, consisting of acetate of lime with a small quantity of lactate of lime. The compounds of lime left upon the filter, as mentioned previously, were carbonate of lime (excess taken) and lactate of lime. All the sugar was changed into alcohol, acetic acid, and lactic acid, equal to 16·79 grms. of acetate of lime, and 19·5 grms. of lactate of lime. Two different processes had here been going on, to a certain extent, simultaneously. The rapid evolution of carbonic acid was chiefly due to the carbonic acid of the carbonate of lime, while the free acetic acid, in spite of an excess of chalk, may partly be owing to the presence of alcohol. In the presence of carbonate of lime a total destruction of the grape sugar had consequently taken place. These two experiments illustrated strikingly the serious changes which, in the course of the manufacture of cane sugar, may result from an imperfect removal of fermentation favouring compounds in consequence of the inefficiency of a boiling heat to arrest their influence. The worst feature of these fatal consequences is, undoubtedly, the change of cane sugar—namely, its transformation into grape sugar, which goes on very rapidly, and that from the fact of its not being suspected by a superintendent unacquainted with the nature of cane sugar, and measures for checking these serious influences not usually being resorted to till too late, if at all.

A quantity of the same ferment as used for the experiments just described, caused, after being dried at 60°—80° Cels., no alcoholic fermentation. Kept at 20° Cels., it soon evolved a putrid odour; yet it gave rise, although slowly, to fermentation, even after ten days. Equal weights of caustic lime and fresh ferment added successively, and in the order above mentioned, to a solution of cane sugar had no effect upon the latter. After being kept at 20°—22° Cels. for several days, the cane sugar could be separated unaltered. I repeated all these experiments, substituting in every case caustic magnesia for caustic lime, and found that the difference between those oxides of alkaline earths manifested itself merely by a different intensity of action. In some instances it appeared to me that their effect corresponded with their degree of solubility in sugar solutions. Thus, for instance, a sufficient amount of caustic magnesia prevents, if thoroughly mixed, the putrid odour of the ferment; yet in cases where equal quantities of caustic lime and caustic magnesia had been applied, the former had always entirely destroyed the fermenting power of the original ferment, while caustic magnesia only partially produced the same effect. Caustic magnesia destroyed far less rapidly the grape sugar; it retarded fermentation to a considerable degree, precipitated largely nitrogenous matters, yet acted slowly in their final decomposition. All these qualities render caustic magnesia far better fitted, as it appears to me, for the refining of raw sugar than for the defecation of raw juice, at least in the tropical climes. The very property of the caustic magnesia which causes its insufficiency for defecation in these localities are, in my opinion, its best recommendation for refining purposes.

The results stated tend to establish the fact that caustic lime must be considered the most efficient of the two basic oxides, particularly so if we adhere to the supposition that the change of cane sugar, and its consequent waste by fermentation, are the most serious features in the manufacture of cane sugar from sugar cane. An examination of the Cuba melados, resulting from the defecations carried out by different quantities of caustic lime, has confirmed me in this opinion. The large percentage of molasses in general made in the plantations, as well as the difference in the relative percentage of the various qualities of sugar, even by pursuing the same system of manufacture with an equally complete set of apparatus, seems to speak in favour of my views of the stated question. Numerous investigations on colonial melado and molasses—for instance, W. Stein's ‡—furnish not less abundant facts, proving the large degree of waste of cane sugar by its transformation into grape sugar, for the latter can, under the best circumstances, only benefit the molasses at the expense of the cane sugar.

When I have argued thus far against an unconditional and exclusive substitution of caustic magnesia for caustic lime in the tropical climes, I probably need not say that I always had in view a judicious application of the lime, assisted at the same time by a careful management of all the various processes connected with the manufacture of raw sugar. An excess as well as a deficiency of caustic lime is accompanied with serious results; yet, if I had to choose, I would always be in favour of an excess, within a certain limit, rather than of the least deficiency. For, as far as the slight excess of caustic lime is concerned, a serious depreciation of the sugar obtainable may be prevented by changing the subsequent treatment of the defecated cane juice or the syrups, while in the latter case quality and quantity will suffer beyond hope. After a careful study of the present methods of manufacturing sugar by improved apparatus, as I had an opportunity of witnessing on a certain class of plantations in Cuba, I arrived at the conclusion that, probably with little expense for apparatus, labour, &c., some of the disadvantages arising from the use of caustic lime for the purpose of defecation might be successfully removed, and thus its superior energetic action in the preservation of the cane sugar advantageously secured. My proposition is, in short, to apply a sufficient amount of caustic lime, so as to secure a slight alkaline reaction in the juice passing for the first time from the (coarse) bone-black filter. Then to concentrate the once filtered juice, if possible, under exclusion of air, by well-regulated heat, discharging the syrup after it has reached 25°—26° Baumé into a serpentine or suitable copper pan, and to add, in a well-divided stream, a sufficient amount of a diluted solution of super-phosphate of lime to neutralise the free caustic lime. Immediately after this object is accomplished, I would raise the mixture rapidly to its boiling point, remove the unavoidable slight excess of acid phosphate by an excess of caustic magnesia, and keep it boiling before filtering in presence of the latter for ten to fifteen minutes. The excess of caustic lime will thus be precipitated, a further serious increase of colour avoided—for caustic magnesia is only slightly soluble in a solution of sugar—and the original colour of the syrup will be rather improved. Large quantities also of impurities of different character will be rendered insoluble, no soluble compounds of any practical consequence added, and still the so-highly desirable slightly alkaline reaction (of less serious consequences) during the progress of the succeeding operations will be restored. One or two sets of common leaf or bag filters, such as are commonly used in sugar refineries, are sufficient to filter rapidly a solution of 15,000 to 20,000 lbs. of sugar.

The effects of caustic magnesia for similar purposes in manufacture are so well and favourably known that the proposition to introduce it as an auxiliary means for

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‡ Dingler's *Polytech. Journal*, xiii., p. 391.

defecation, and particularly as a most efficient means for the refining of raw sugar, cannot appear strange. I consider caustic magnesia, in consequence of my own experience during my occupation as a practical sugar refiner, a very excellent means for the clarification of the raw sugar and of the syrups for purging. Its scarcity for such technical purposes as those commented on appears to be a principal cause of its high price. Raw material for the manufacture of magnesia, as Mr. Kessler very judiciously remarks, abounds in almost every country. Nothing, in fact, remains to be done but to create a demand.

PHARMACY, TOXICOLOGY, &c.

Alcohol as a Test for Croton Oil.

MR. R. WARRINGTON, F.R.S., has published in the *Pharmaceutical Journal* some experiments on the British Pharmacopœia test for croton oil, which have led him to conclude that the use of alcohol as a test for the purity of the oil is of no value. His own opinion, he states, is that freshly expressed oil, or rather *oil* expressed from *fresh* seeds, either abroad or in this country, does not dissolve in alcohol sp. gr. ·794—·796 to a greater extent than 20 per cent. at 50°; but that if croton oil has undergone a chemical change, such as resinification or oxidation by time and exposure to air, or has been expressed from seeds which have become changed in the same manner, then the oil is freely dissolved by the alcohol. It follows that "a test which is open to many weighty objections, both from the influence of small fluctuations of temperature, and for indicating the purity of a material liable to such marked differences from the effects of such natural, and in some cases inevitable chemical changes is perfectly useless as a reliable indication of purity."

On Hoffmann's Test for Phosphorus, and the Formation of Hyposulphurous Acid, by A. FROEDHE.*

L. HOFFMANN's method of detecting phosphorus in cases of poisoning, with some remarks, will be found at page 164, vol. vii., of the CHEMICAL NEWS. "The process consists in distilling from the viscera, mixed with sufficient water and a small quantity of dilute sulphuric acid, about two drachms of fluid, mixing a few drops of sulphide of ammonium with the distillate, and evaporating the whole to dryness on a porcelain dish. If phosphorus were present in the viscera, even in the most minute quantity, a drop of the solution of perchloride of iron will produce a deep violet and brownish evanescent reaction." This reaction is now explained by Froedhe as the consequence of the formation of some hyposulphite of ammonia on the evaporation of sulphide of ammonium to dryness.

PROCEEDINGS OF SOCIETIES.

GEOLOGICAL SOCIETY OF GLASGOW.

DR. A. T. MACHATTIE, F.C.S., delivered a lecture "*On Metamorphism, with Special Reference to the Chemical Changes in Rocks.*" Dr. Machattie, after some introductory remarks, said:—Let me remind all that, so far as we know, the earth is no heavier now than at its creation, so that all changes have been effected in matter existing indestructibly throughout every stage of our world's history. All the rock masses of our earth are either the original rocks or they have been produced from the disintegration of those that have preceded them. It is therefore obvious that, if we trace back, we must arrive at certain rocks which have not been produced from others—that is, there must have been some original rock or rocks of one kind or another, although it does not follow that there is any of these still in existence. Such considerations bring us to the necessity of forming some conclusions on the original condition of the earth, or rather, the condition of the earth before what we properly term *rocks* were formed.

Many phenomena lead us to conclude that the earth was once in a molten state:—1. The shape of the earth is that which would be taken by a rotating liquid mass; 2. When we descend into the crust of the earth by pits, wells, &c., the temperature invariably rises about 1° F. for every fifty or sixty feet; 3. Volcanoes eject molten minerals, which require the highest temperature of our furnaces for their fusion; and 4. The density or specific weight of the earth being unaccountably low, on the supposition that the earth is solid throughout, leads us to the belief that the central portions must be greatly expanded or rarified; and we know of no expansive force except heat. The prevalent opinion is, that we stand upon a hard crust which has cooled, and this crust we have for examination, together with anything which active volcanoes may throw out from lower depths for our inspection—that is, lavas and volcanic products generally. We might expect the original rocks (if they exist now) to be lowest, and as in all cases where geologists have been able to penetrate the upper rocks, the last rock which they encounter is granite, it has usually been assumed that granite is the oldest rock. It was at one time, indeed, considered the original cooled crust, but now it is not even believed to be the oldest rock with which we are acquainted; in fact, we have granite of all ages.

There are four methods by which rocks may now be produced:—1. Volcanoes may eject *igneous* rocks; 2. The surface of the earth may be altered by certain mechanical and chemical agencies—*e.g.*, water and the constituents of the atmosphere; 3. Remains of plants may give rise to coal; 4. Air may blow sand or finely-divided matter into heaps, which afterwards consolidate. If the earth was once molten, all rocks must either be themselves igneous or they must have been produced at once, or by successive stages from igneous rocks. The only rocks which we know to be of igneous origin are the so-called trappean and volcanic rocks. These contain all the elements of the stratified rocks, and I now pass to consider the manner in which igneous rocks become decomposed or broken up. Water, in freezing, expands in the pores of rocks and splits the mass into fragments. Water also washes away fine powder of any kind. Those agencies which act chemically are the oxygen and carbonic acid of the air, and, to a less degree, water. Oxygen combines with the iron of igneous rocks, and converts it into rust or oxide of iron. Carbonic acid, when in water, dissolves out the lime and converts it into carbonate of lime, for the further production of limestones, marble, calcite, arragonite. Water may combine with the products of such changes, as when carbonate of iron becomes, by oxidation and hydration, the hydrated peroxide of iron or brown hæmatite. When acted on as above, the constituents of igneous rocks are carried off and deposited under various conditions, forming the different kinds of limestones, clays, sandstones, and stratified rocks in general.

The metamorphism which we shall principally study at this time is accompanied by chemical change, or change in composition. When chalk becomes marble, or sandstone passes into quartzite, no difference of composition is observable, although these are instances of very decided metamorphism. We cannot, however, altogether avoid reference to this kind of change, but we shall

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* *Annalen der Chem. und Pharm.*, bd. cxxx., s. 127.

first observe certain results which may follow chemical metamorphism. Chemical metamorphism may result in (1) a mere re-arrangement of the elements which compose any rock, so as to produce new chemical compounds, without altering the ultimate or elementary composition of the rock changed. For example, a rock containing two compounds, AB and CD, might have these re-arranged as AC and BD; (2) the change may involve a loss of constituent matter, as when by loss of water clay becomes slate; (3) the change may consist in the addition of new matter, *e.g.*, when anhydrite by combining with water becomes gypsum; (4) we may have metamorphism produced by loss of some constituents and addition of others, the kind of change, as might be anticipated, by far the most frequent.

Before referring to the causes of change in matter, we shall shortly glance at the nature of the matter itself. It is surprising how few of the elements form the great bulk of unstratified and stratified rocks. Of the whole sixty-four or sixty-five elements in nature, only twelve may be said to enter largely into the formation of rock masses. Six of these are metals—potassium, sodium, calcium, magnesium, aluminium, iron. Six are non-metals—hydrogen, oxygen, carbon, silicon, sulphur, and chlorine. The relation which these twelve elements bear to the other fifty-three, so far as quantity is concerned, may be likened to the relation borne by the foundations and massive walls of a house to the ornaments with which these walls may be decorated. The twelve abundant elements occur in nature chiefly in a state of combination with one another, and the principal compounds which are produced by their union are water (hydrogen and oxygen), carbonic acid (carbon and oxygen), silica (silicon and oxygen), sulphuric acid (sulphur and oxygen), common salt (chlorine and sodium), and potash, soda, lime, magnesia, alumina, which are the oxides of the metals potassium, sodium, calcium, magnesium, and aluminium respectively. Lastly, we have iron and oxygen combining to form the different oxides of iron. Of these compounds the great bulk of the crust of the earth is composed. Granite contains the twelve elements referred to above, with the exception, perhaps, of any notable amount of hydrogen, carbon, and chlorine; but as hydrogen is one of the constituents of water, carbon exists in the atmosphere, and chlorine is one of the elements of common salt, we may say, practically, that in a granite earth, surrounded by a salt ocean, and an atmosphere such as we now breathe, we have everything necessary for the formation of all the known stratified rocks. It is no wonder, then, that granite has been so long considered the great storehouse of raw material, from which the earth's crust, as we now find it, has been slowly elaborated by the operation of air, water, and the great forces of nature.

In returning to the various results of metamorphism already alluded to, it is clear that the first kind of change, that in which mere re-arrangement occurs, may be expected to occur only in rocks of a complex constitution, for, in more simple cases, change of form or aggregation may occur, but not of composition. Silica, for example, if taken alone can never produce or become anything else but silica, and the same remark applies to carbonate of lime. Limestone, marble, calcite, and arragonite may be different in appearance and in other properties, but chemically they are identical. In the case, however, of a complex rock, such as clay slate, containing silica, alumina, oxide of iron, lime, magnesia, potash, &c., instances are recorded in which it passes into gneiss, in which latter rock the elements are arranged very differently, yet the clay slate and gneiss may have the same composition when analysed.

Changes accompanied by loss of matter are of considerable importance. Clay, by loss of water, becomes slate. Coal, when heated by the intrusion of trap, passes into coke from a loss of bituminous matter. It is evident further, from what we know of the mechanical action of water, and the solvent power of water, containing carbonic acid, that metamorphism, with loss of ingredients, must be very frequent, although for the most part it is impossible to trace back to their sources and prove that materials once carried away in solution or suspension have been derived from any particular rocks. The simplest cases of metamorphism, by increase of matter only, are obviously just the converse of those mentioned under the preceding kind of change—that is to say, that instead of loss of water we have addition of, or combination with, water. Thus, anhydrite becomes gypsum; red hæmatite becomes brown hæmatite, and so on with other hydrated minerals. Such cases only require for their explanation the presence of water—a condition which is admitted to be almost of universal occurrence. The metamorphism in which both loss and gain is evident is very frequent, and is by far the most important kind of change. It involves all the different phenomena and causes of metamorphism, and merits a somewhat full treatment.

There are a considerable number of well-known rocks occurring in immense quantities, and bearing such striking evidence of change, that geologists have for a long time termed them "metamorphic rocks." It will be understood by all those acquainted with the barest elements of geology that I now refer to such rocks as quartzite, hornstone, clay slate, mica schist, chlorite schist, talc schist, hornblende schist, and gneiss; also, primary and crystalline limestones generally, marble and dolomite. If we disregard quartzite and hornstone, and limestone, we shall have left a series of metamorphic rocks which in composition present remarkable similarity. Clay slate, gneiss, and the various schists contain almost exactly the same ingredients, although the preponderance of individual compounds in each rock confers on it certain specific and distinguishing characteristics. Gneiss is generally considered an excellent example of the more complete stages of metamorphism, in which the changed rock still retains evidence of stratification or aqueous deposition. Its composition is similar to that of clay slate; the arrangement of their ingredients is very different. Gneiss may be stated to contain the crystalline ingredients of granite in a stratified form; and just as we have granite consisting of quartz, feldspar, and mica, in an unstratified condition, so we have gneiss, made up of quartz, feldspar, and mica, in a stratified form; and corresponding to the varieties of granite called syenite and protogine, in which the substitution of hornblende and talc respectively for mica constitutes the specific character, we have varieties of gneiss which are called hornblendic (syenitic) gneiss and talcose gneiss, from the presence of the minerals hornblende and talc, here substituted for the mica of gneiss proper, precisely as in the case of true granites.

The appearances which induce us to consider rocks metamorphosed are chiefly induration, foliation, crystallisation, and various kinds of contortion. The question how, or by what agencies, these results have been brought about, may be answered in two ways: first, we know with tolerable definiteness what forces are at work in nature; and, secondly, we can produce the characteristic appearances and changes artificially to a greater or less extent. Some of the simpler results of metamorphism may be produced by long-continued heat; for example, the conversion of sandstone into quartzite. Heat, accompanied by pressure, may change clay into slate, and chalk into marble; but the great family of schistose rocks have been produced, in all probability, by more complicated means than heat and pressure. That the schistose and crystalline rocks have been formed from ordinary stratified rocks is presumed for the following reasons:—(1.) The similarity of composition between them and ordinary argillaceous deposits. (2.) The presence in schistose rocks of fossils, the structure of which is perfect or uninjured. (3.) Some schists contain carbonaceous matter (apart altogether from carbonates), the presence of which can only be accounted for on the supposition that the remains of plants or animals were imbedded in the rocks during deposition. (4.) The actual passage of a common stratified rock into a crystalline and schistose one is frequently observed. The above arguments not only prove the source of schists, but also throw some light on the mode of their formation. The presence of uninjured fossils puts fusion out of the question, and, accordingly, we have to decide how crystals can be formed in a rock without fusion or aqueous solution. That they can be so formed is undoubted. Crystals, with our present knowledge, cannot be considered as unmistakeable evidence either of fusion or solution.

On the supposition that clay is the source of the principal metamorphic rocks, synthetic experiments have been made on clays by heating them under pressure with water containing alkaline silicates in solution, and by this means certain important results have been obtained. Perfect crystals of quartz, feldspar, mica, and pyroxene have been formed in these experiments at a red heat. Wood has also been converted into anthracite, with the simultaneous production of oils having all the properties of natural petroleum. Further, vitreous or glassy obsidian has passed into a highly crystalline trachyte.

The arguments in favour of the action of heated water under pressure, sometimes called "hydrothermal" action, as a metamorphic agency are chiefly these:—1. Metamorphosed rocks are seldom uniform in structure, and whilst fusion almost implies uniformity, the action of superheated steam does not. 2. The crystalline minerals can be produced by "hydrothermal" action at a much lower temperature than their fusing point. 3. Quartz is almost universally present in metamorphic rocks, and quartz is a constant product of the action of superheated water on silicates on the small scale. Moreover, fused quartz or silica has a specific gravity on cooling of 2·3 (water = 1), and fused quartz has never yet been found to crystallise when cooled. The metamorphic rocks contain, on the other hand, crystallised quartz, having a specific gravity of 2·6. The quartz produced by "hydrothermal" action is crystallised, and possesses the specific gravity of 2·6—that is, it is identical with that found in natural metamorphosed rock masses. 4. Water is found in all rocks.

That a perfectly crystalline structure may be developed without fusion is well known: vitreous arsenious acid becomes crystalline on exposure to the air for some time, so does vitreous or barley sugar. The fibrous wrought-iron of railway axles is also capable of assuming a crystalline structure.

The sum of these remarks seems to be this—that heat, pressure, and water can, together, produce those effects which are characteristic of the schistose and other metamorphic rocks. In this statement I include gneiss, because, although the similarity between granite and gneiss has given rise to the belief that gneiss is composed of disintegrated granite, this similarity may be turned to prove that granite is metamorphosed gneiss. For, although it may be admitted that when any metamorphic rock contains minerals similar to those found in granite, this argues similarity in their mode of formation, and so long, therefore, as we consider granite of igneous origin we must admit the probability of the same origin for the other; yet as we know of certain rocks which contain granitic minerals, and yet which have been produced with the intervention of water, this would argue that the formation of granite involves the presence of water too; but into this question I cannot now enter.

Besides the agencies supposed to have combined to produce the schistose metamorphic rocks, we have certain minor causes of metamorphism, such as mixture of contiguous rocks; double decomposition, as in the formation of some dolomites where sulphate of magnesia may be supposed to react on carbonate of lime, producing sulphate of lime and dolomite, and lastly, volcanic exhalations.

In conclusion, let it be remembered that the various causes of metamorphism referred to are quite legitimately used to explain the results. Heat, pressure, double decomposition, aqueous solution, mixture of contiguous matter, and volcanic exhalations, are not imaginary. If we reflect on what the condition of rocks a few thousand feet beneath us must at all times be, we shall be reminded of the constant action of heat and pressure under all the surface of the earth. Water with its mechanical and chemical effects is even now everywhere at work. Double decomposition, mixture of matter in contiguity, and the influence of volcanic exhalations, are processes the action of which may be verified by any one at any time. Metamorphism, then, considered in the sense in which we have been studying it, is a series of alterative processes—slow, gradual, and continuous, such as we now find going on around us in the mineral matter of our globe. The explanations given of the changes observed in the rocks of the earth's crust are such, therefore, as commend themselves to those who would judge of the past by the present, and read the history of our planet by the light of acquired knowledge or experience.

ACADEMY OF SCIENCES.

January 23, 1865.

M. **Corenwinder** communicated a memoir "*On the Chemistry of Beetroot.*" The author has analysed a number of roots grown with different kinds of manure, and found the sugar to vary from 5 to 14 per cent. In the ashes the only thing remarkable noticed was the fact that carbonate of soda sometimes completely replaced carbonate of potash, but in these roots the sugar was always low.

Another memoir read was by M. H. Marès "*On the Production of Manure by Sheep: the Relation between the Manure Produced and the Food Consumed.*" The author made three experiments, and in two fed his sheep on materials not at the command of English farmers—namely, the marc from the wine presses and mulberry leaves. We need not notice the results with these; but in a third experiment he fed with lucerne alone, and with this he made out that 82 per cent. of the nitrogen in the plant passed into the manure dropped.

M. Jullien contributed some "*New Facts on Cast Irons and Steels.*" The author has adopted Karsten's views of the constitution of cast iron, steel, and alloys, but modifies them by asserting that metals do not combine with one another, but one metal dissolves in another. The object of the long memoir presented to-day is to demonstrate—1st, that metals do not combine with each other; 2nd, that iron does not combine with either carbon, silicium, or nitrogen; and 3rd, that a mixture of hydrate of lime and dry hydrated sulphate of soda presents all the characters of a solution, but none of those of combination. M. Jullien then gives us his ideas on the constitution of irons and steels in a series of propositions, of which we have only space for one or two. Liquid cast iron, he says, is a solution of liquid carbon in liquid iron. Soft steel is a solution of amorphous carbon in either amorphous or crystallised iron. Grey pig, obtained by casting in hot moulds or sand, is a mixture of graphite and steel, the components, iron and carbon, being both in the amorphous state. We will quote one more assertion. Graphite being amorphous, carbon cannot crystallise without becoming diamond; the supposed crystals of graphite are really casts of other crystals. The author then gives some other consequences which flow from his theory. Liquid glass, he says, is the solution of a neutral silicate in one of its components. Granite is a liquid glass cooled slowly. Lava, liquid glass cooled suddenly. Bronze cooled slowly, a solution of crystallised tin in amorphous copper. Bronze cooled suddenly, a solution of amorphous tin in amorphous copper. Red phosphorus is the amorphous condition of an allotropic state of phosphorus, the crystalline form of which is not yet known.

MM. Boivin and Loiseau presented another note "*On the Sucrates of Lime.*" The authors are still occupied with the bibasic sucrate; and the fact of capital interest in the paper is the remark that to remove the lime from solutions in sugar plenty of carbonic acid must be employed.

M. Kekulé presented a note "*On the Atomic Theory, and the Theory of Atomicity.*" All that M. Kekulé says on this subject is worthy of attention, and we shall give in another place a longer abstract of his paper than we could here.

M. Terreil communicated "*Analysis of a Bronze and an Iron Ore*" found in one of the bone caverns of Perigord. The composition of neither presented anything remarkable.

M. Faye read the second part of his memoir "*On the Physical Constitution of the Sun;*" and a communication on the same subject was received from M. Chacornac. We have said that M. Faye regards the sun as a fluid mass undergoing a gradual cooling; and upon this assumption he explains all the solar phenomena. We are not certain that we rightly understand the author; but we fancy he believes the sun to be still in a liquid state—a state which, he says, is purely transitory; but he comforts us with the assurance that the next stage, in which the whole of the mass will contribute to the emission of light and heat, now only effected by the photosphere, will last millions of years; and therefore we may thank God that the whole creation is not threatened with speedy extinction.

NOTICES OF BOOKS.

Annalen der Chemie und Pharmacie. January, 1865.

The first paper is by Linnemann, "*On Benzophenon and Some of its Derivatives.*" Benzophenon, $C_{13}H_{10}O$, is obtained by the dry distillation of a mixture of benzoate of calcium and caustic lime. The distillate is a mixture of benzole, bitter almond oil, benzophenon, and other matters. The first can be removed by evaporation on a water bath, and then, after repeated distillations, a yellow oily fluid is obtained, which, on cooling, settles into a mass of crystals. A brown liquid is separated from this by pressure between folds of blotting-paper, and now, by solution in hot spirit of wine and one or two recrystallisations, benzophenon is procured as a snow-white crystalline mass composed of fine long needles, or if deposited from a hot saturated solution, in the form of glistening prisms. With bromine benzophenon forms a tri- and also a pentabromated compound. By treatment with sodium amalgam it furnishes a peculiar body, which the author has named *Benzhydrol*—$C_{13}H_{12}O$. Benzhydrol has some of the properties of a monatomic alcohol, but does not yield an aldehyde; oxidising agents simply re-convert it into benzophenon. Benzhydrol dissolves in fuming nitric acid, a lively reaction ensues, and an oily body is produced, which, on separation and solution in alcohol, gives buff-coloured needles of *binitrobenzophenon*—$C_{13}H_8(NO_2)_2O$. By chromic acid, as before hinted, benzhydrol is re-converted into benzophenon. In this way its behaviour resembles that of aceton, which is, by the action of sodium amalgam, converted into isopropylic alcohol, from which oxidising agents reproduce aceton. With bromine benzhydrol yields bibromated benzhydrol, thus differing in its behaviour from a normal alcohol. By sodium amalgam benzhydrol is reproduced from this compound. The author then gives an account of some ethers of benzohydrol, which is remarkable for its ready etherification. Benzhydrol ether is obtained by the simple distillation of benzhydrol, or even by allowing to stand for several hours at a weak heat. Mixed ethers of benzhydrol and methyl or ethyl-alcohol are formed at a moderate temperature, when a solution of benzhydrol is added to a mixture of either of the above alcohols and sulphuric acid. Acetic, benzoic, and succinic ethers are formed by simply melting the acid with the alcohol.

We must refer the reader to the original paper for the full account of these bodies, but may mention some peculiarities of the *ethyl-benzhydrol ether*. This is immediately after distillation a colourless, odourless, and strongly refractive liquid of the consistence of glycerine. In a very short time after distillation, if exposed to the light, it becomes coloured, and then appears green by reflected and pale yellow by transmitted light. The colour disappears when the substance is gently heated, or shaken, or even put in a dark place, and is again coloured on exposure to light. On keeping for some months, it becomes insensible to light, and after a re-distillation, never again acquires its sensibility. The acetic ether possesses similar properties.

Passing from the ethers of benzhydrol, we may shortly notice the behaviour of benzophenon with zinc and sulphuric acid. The product of this reaction extracted by alcohol and purified by several re-crystallisations, showed, on analysis, the composition $C_{26}H_{22}O_2$. This body the author compares with that derived from aceton, and accordingly names it *benzpinakon*. Thus—

$$\underbrace{2C_3H_6O}_{\text{Aceton.}} + H_2 = \underbrace{C_6H_{14}O_2}_{\text{Pinakon.}}$$

$$\underbrace{2C_{13}H_{10}O}_{\text{Benzophenon.}} + H_2 = \underbrace{C_{26}H_{22}O_2}_{\text{Benzpinakon.}}$$

Oxidising bodies re-produce benzophenon from benzpinakon. Sodium amalgam seems to effect no change in the chemical composition of benzpinakon, but alters its physical character, and the author names the new product *isobenzpinakon*. The former crystallises in white transparent prisms, the latter is a thick, colourless, syrupy, strongly refractive liquid.

The author returns to the curious fact that benzophenon forms very different compounds with hydrogen from an alkaline solution and hydrogen from an acid solution, and mentions that acrolein behaves in a similar manner.

The next paper is by F. Beilstein, "*On Xylol.*" Toluol has been found to be identical with the mixed radical methyl-phenyl,

$$\begin{matrix} C_6H_5 \\ CH_3 \end{matrix};$$

and it has been conjectured that xylol might be identical with ethyl-phenyl. This, however, has been shown not to be the fact. The author prepared his xylol from coal-tar oil repeatedly treated with sulpuric acid and soda ley, and lastly by the addition of sodium, until that metal remained perfectly bright. He then distilled and collected what he finds to be pure xylol at 141°. Mansfield on fractionating coal tar noticed that the thermometer became stationary from 80° to 85° at 113°, from 143° to 145°, and from 170° to 172°. The experiments of Ritthausen and Hildenkamp gave closely concordant results. These agree with the boiling points of the following compounds:—

Benzol, C_6H_6	82°
Toluol, C_7H_8	111°
Xylol, C_8H_{10}	139°

Mr. Church has given the boiling points of the benzol series in the following table, which is to be found in most manuals:—

Benzol, near	80·8°
Toluol "	103·7°
Xylol "	126·2°
Cumol "	148·4°
Cymol "	170·7°

Beilstein supposes that Mr. Church's products were not sufficiently fractionated, or that he operated upon an insufficient quantity of coal-tar oil.

The author then gives an account of xylo-sulphuric acid and some of its salts, and afterwards a description of the product of the oxidation of xylol by sulphuric acid and bichromate of potash. This is *terephthalic acid*, $Ꞓ_8H_6Ɵ_4$, the salts of which are next described. The acid is identical with that obtained by Dr. Müller by the oxidation of cummin oil by chromic acid. The nitro derivatives of xylol are next described, and lastly we have an account by Wahlforss of the action of bromine on xylol.

A short paper by Rudolph Fittig gives a preliminary notice of "*Methyl-benzyl.*" This he has prepared by submitting a mixture of bromated toluol and iodide of methyl to the action of sodium amalgam. The result is methyl-benzyl,

$$\left.\begin{matrix}Ꞓ_7H_7\\ Ꞓ\ H_3\end{matrix}\right\}$$

a very different body from methyl-phenyl,

$$\left.\begin{matrix}Ꞓ_6H_5\\ Ꞓ_2H_5\end{matrix}\right\}.$$

The former body boils at 139°, or six degrees higher than the phenyl compound. The sulpho acid and the nitro compounds differ from those of xylol mentioned in the foregoing paper.

Fittig has also prepared ethyl-benzyl,

$$\left.\begin{matrix}Ꞓ_7H_7\\ Ꞓ_2H_5\end{matrix}\right\}.$$

It boils at 159°, and shows no resemblance to cumol.

The same author has a short paper "*On the Behaviour of Monochlorated Benzol to Alcoholic Solution of Potash,*" in which he asserts that no phenol is produced by the reaction of the two bodies.

The next paper, by Riche and Berard, "*On the Bromine Derivatives of Benzol and its Homologues,*" we have noticed before.

An article by Dr. Rautenburg, "*On the Estimation of Urea and Ammonia,*" gives a modification of Liebig's process for urea, which we shall extract at length.

The next paper is by Heintz, "*On the Ethyl Derivatives of Hydantoin and the Formation of Hydantoinic Acid from Glycocoll.*"

After some other extracted articles, we find one by Bünsen, "*On the Extraction of Thallium from the Mother Liquors of Sulphate of Zinc.*" While flue-dust is to be had, no other commercial source of thallium is worthy of notice. The presence of the metal in these mother liquors might have been anticipated.

"*On some Derivates of Aceton and its Conversion into Allyl*" is the title of a paper by Borsche and Fittig, in which they notice the chlorinated compounds of aceton, and show how allyl is produced from some of them.

Liebig's note on "*Extract of Flesh*" also appears in this journal; and then we have some short preliminary communications by Linnemann. The first is "*On the Behaviour of Acrolein to Hydrochloric Acid and Zinc.*" It forms a mixture of allyl and propyl alcohols, and a third body $Ꞓ_6H_{10}Ɵ_2$. The second gives the "*Behaviour of Bromine to Propyl Alcohol.*" There is formed a mixture of bromide of propyl, bromoform, and other bodies containing bromine, among which are found the bromine substitution products of aceton. Bromhydrin is not found. Bibromated propyl, by treatment with moist oxide of silver, gives a brown, weakly acid, syrupy liquid, which, on distillation with acid sulphate of potash, gives acrolein, and, by treatment with iodide of phosphorus, gives iodide of allyl. Glycerin also is formed.

The last paper in this unusually interesting number of the *Annalen* is one we have already noticed in the proceedings of the French Academy.

Bulletin de la Société Chemique de Paris. December, 1864.

The proceedings of the Chemical Society of Paris are of less interest to us than they should be, seeing that by far the greater number of papers read before the Society are contributed to the Academy of Sciences, and, therefore, published in the weekly *Comptes Rendus*, while the *Bulletin* only appears once a month. Among the original papers we find one by M. Lauth "*On Aniline Black,*" a full abstract of which we shall give in our next number. Another paper is by Schaller "*On the Preparation and Formula of Carminic Acid.*" The author's mode of preparation is the following:—An aqueous solution of cochineal is treated with acetate of lead and a little acetic acid. The precipitate is collected on a filter and washed, and then decomposed by sulphuric acid. The filtrate from the sulphate of lead is treated a second time in the same way, taking care to have no excess of sulphuric acid. After the second or even a third treatment the carminate of lead is decomposed by sulphuretted hydrogen, and the solution of carminic acid is evaporated to dryness. Solution in alcohol then frees it from all mineral matters. On concentrating the alcoholic solution some mammellar yellow crystals are deposited along with the carminic acid. They may be removed by a washing with cold water, and the carminic acid may then be re-crystallised from alcohol or ether. The author's analyses lead to the formula $Ꞓ_9H_{10}Ɵ_6$. Carminic is a bibasic acid, and, therefore, its formula may be written

$$\left.\begin{matrix}Ꞓ_9H_8Ɵ_5\\ H_2\end{matrix}\right\}Ɵ.$$

The analysis of memoirs on pure and applied chemistry, which, as usual, accompanies the *Bulletin*, is very full of interesting matter, and we shall largely avail ourselves of its contents.

NOTICES OF PATENTS.

1285. *Protecting the Bottoms and Sides of Wooden and Iron Ships and other Submerged Structures.* C. P. Coles, Southsea. Dated May 21, 1864.

As a protection from the barnacles, Captain Coles proposes to cover the bottom of his cupola ships, as well as those of timber construction, with stucco, plaster, or hydraulic cement, first driving iron nails into the hull to assist the adhesion of the latter, and in the case of iron vessels applying a thin sheathing of wood underneath the plaster.

1286. *Apparatus for Increasing the Illuminating Power of Gas, and for Producing Gas by the Vaporisation of Hydrocarbons and Essences of Petroleum.* R. A. Brooman, Fleet Street, London. A communication. Dated May 21, 1864. (Not proceeded with.)

The apparatus herein described is intended to fulfil the purposes of a carburetter, and of a gas generator. It consists of a strong metallic vessel in the form of a double cylinder having one portion superposed, which serves as a reservoir for the petroleum or other hydrocarbon, and the lower cylinder is employed as a vaporiser.

1270. *Improvements in Treating Oil and Spirit Varnishes, and also Drying Oils and Turpentine, in order to Bleach and otherwise Improve the same.* J. E. G. Freeman and C. H. Freeman, Battersea. Dated May 19, 1864.

The oils and varnishes about to be treated according to this process are allowed to stand at rest for two or three months, or until all matters in suspension have subsided, they are then racked off into bottles or other vessels capable of being closed perfectly air tight; these bottles should be only half filled with the oil or varnish, and then the air remaining above is replaced by pure oxygen gas. The stoppers having been securely fastened, the oil or varnish is agitated in contact with the gas, or the vessel may be kept constantly rotated. After a short treatment in this way the oils, &c., will have become much paler in colour, and improved in other respects, particularly in their drying qualities.

It is not easy to perceive in what manner oil of turpentine can be improved by this method of treatment, for by the absorption of oxygen it must become more highly charged with resin, and so far deteriorated. The mixture of hydrocarbon vapours and oxygen contained in these bottles would be possessed of highly explosive properties in the event of its meeting with flame.

1296. *Obtaining Sulphur from Alkali or Blue Waste.* B. Jones, Warrington. Dated May 25, 1864.

The inventor liberates the sulphur from combination with calcium and its salts by operating upon them with high pressure steam in the presence of water, using for this purpose a closed iron vessel called a digester.

1320. *Improvements in Lamps, Vessels, Tubes, and Cocks, especially Useful for Preventing the Transmission of Flame or Explosive Action when Using Petroleum, Camphine, &c.* J. H. Burke, London. Dated May 27, 1864. (Not proceeded with.)

This suggestion refers to a novel means of producing the multitubular blocks of metal which Sir Humphry Davy and Mr. Maugham found so efficient for the purpose of cooling flame and preventing the ignition of explosive vapours. The inventor takes two strips of metal, one being plain and the other finely crimped or corrugated, and then by rolling them up tightly together forms a bundle of metallic tubes, which, being of suitable small dimensions, is very efficient as a fire-proof diaphragm in lamps and burners intended for the combustion of camphine and petroleum.

1327. *An Improved Paint.* J. Thomas, Battersea. Dated May 28, 1864. (Not proceeded with.)

For the purposes of an ordinary paint as well as one which is particularly adapted to coating the bottoms of iron and timber ships, the inventor employs copper slag reduced to fine powder and mixed with oil. In this condition its colour is nearly black, but by previous calcination of the ground copper slag a red or brown pigment may be produced, and the colour may be modified by varying the temperature at which the roasting operation is conducted.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

2883. A. A. Croll, Coleman Street, London, "Improvements in the preparation of materials to be used in the purification of gas for illumination."—Petition recorded Nov. 18, 1864.

3115. W. Bardwell, Great Queen Street, Westminster, "An improved method of utilising sewage and urine, and for facilitating their passage through pipes, thereby preventing the pollution of rivers and streams."—Dec. 16, 1864.

3131. A. A. L. P. Cochrane, "Improvements in apparatus for heating and evaporating liquids and fluids."—Dec. 17, 1864.

3252. L. P. E. Max, Paris, France, "Improvements in treating oils and hydrocarbons, and in apparatus for the same and other operations in which matters have to be purified, clarified, and refrigerated or condensed." A communication from E. Laporte, Boulevart de Sebastopol, Paris.—Dec. 30, 1864.

4. E. Bevan, Birkenhead, Cheshire, and A. Fleming, Liverpool, Lancashire, "An improved jacket or protector for metallic and other vessels and structures containing solid substances, liquids or gases, to prevent radiation of heat from, or communication of heat to, such vessels and structures."—Jan. 2, 1865.

40. J. E. Vigoulète, Nelson Square, Peckham, Surrey, "Improvements in the treatment of carbonaceous minerals, and in apparatus for preparing agglomerated fuel."

50. Thomas Richardson, Newcastle-upon-Tyne, and M. D. Rücker, Leadenhall Street, London, "Improvements in treating guano."—Jan. 6, 1865.

57. E. Beanes, Priory Road, Kilburn, Middlesex, and C. W. Finzel, Bristol, "Improvements in the construction of vacuum pans."—Jan. 7, 1865.

80. W. Clark, Chancery Lane, Middlesex, "Improvements in preparing or treating wood and other vegetable fibrous materials for the manufacture of pulp for paper." A communication from Z. Orioli, A. A. Fredet, and P. A. H. Mabussiere, Paris.—Jan. 10, 1864.

Notices to Proceed.

2235. A. C. Kirk, Bathgate, Linlithgowshire, N.B., "Improvements in the manufacture of ice."—Petition recorded Sept. 13, 1864.

2260. J. H. Simpson, Kilmeena, Ireland, "Improvements in printing by electricity for telegraphic and other purposes."—Sept. 16, 1864.

2278. Frederic Yates, Birmingham, Warwickshire, "Improvements in the distillation of volatile minerals, vegetable, and other organic matters."—Sept. 17, 1864.

2298. W. Lawrence, Cornwall Villas, Paddington, Middlesex, "Improvements in apparatus for mashing and for cooling worts and other liquids."—Sept. 20, 1864.

2332. W. Larcom, Gosport, Hampshire, "Improvements in protecting the sides and bottoms of ships and other structures of iron, and in materials to be employed therein."—Sept. 22, 1864.

2339. W. Palmer, Jun., Southweald, Essex, "Improvements in the manufacture of candles."—Sept. 23, 1864.

2504. H. Tucker, Newton, Mass., U.S.A., "An improved process for bronze-colouring iron."—Oct. 11, 1864.

2695. J. F. Brinjes, Fieldgate Street, Whitechapel, "Improvements in apparatus for the reburning of animal charcoal."—Nov. 1, 1864.

3207. E. Morewood, Cheam, Surrey, "Improvements in coating metals."—Dec. 24, 1864.

CORRESPONDENCE.

Continental Science.

Paris, January 24.

In the absence of more useful intelligence, I must give you some idea of a method of preserving beer for an indefinite period, rather vaguely described by M. Michel. Given, beer arrived at the last term of the alcoholic fermentation. M. Michel adds thereto a "complimentary ferment," which immediately precipitates everything which is capable of setting up a new fermentation, and the beer is clarified as well as preserved. What this complimentary ferment is we are not told, but we are told that it is quite innoxious, and rather "hygienic" than harmful. Perhaps some brewers of pale ale for export at Burton would be glad to get hold of M. Michel's secret, and I should be glad to experiment on some beer he has operated upon.

Your readers will rejoice to learn that M. Stas, of Brussels, has published more results of the investigations on which he is known to be continually engaged. His present instalment, read before the Berlin Academy of Sciences on January 14, is occupied with determinations of the atomic weights of silver, iodine, bromine, and chlorine, the principal object of his experiments being to ascertain whether the atomic weight of silver in combination with these three haloids is the same, and whether it agrees with Prout's law. Further than this, the indefatigable author gives new determinations of the atomic weights of nitrogen, bromine, silver, lithium, potassium, and sodium. I will send you the entire memoir as soon as I receive it; it is entitled, "*New Researches on the Laws of Chemical Proportion, and on the Mutual Relations of Atomic Weights.*"[*] Of all recent determinations of atomic weights, probably none can compare for accuracy with those of M. Stas. Your readers, however, are well acquainted with his method and appliances, and I need say no more at present.

It is difficult to be an inventor now-a-days. A man with an idea in his head must not go to sleep on it, but bring it out as soon as he can, or he is sure to be forestalled. There is M. Flandrin, for instance, who last July deposited a sealed packet with the Academy. That packet contained the suggestion of a plan for driving machinery with ammoniacal gas, starting, of course, with the liquefied gas. But during this time M. Tellier has occupied himself with the same subject, and for the last fortnight has set all Paris talking about his invention. The two inventors start from the same point. Given, a vessel of liquefied ammonia, turn a tap, and the gas escaping will drive forward a piston; this being arranged to cut off the supply of gas, and to admit some water, a vacuum is produced by the absorption of the gas, and the piston is forced back by atmospheric pressure. The thing is as simple as possible; but as only one stroke of the piston will do any work, you require a number of cylinders. With four, however, with a stroke of 0·6 of a metre and a diameter of 0·4 m., M. Flandrin says he will do the work of forty hours.

M. Tellier proposes to drive an omnibus for an hour with 10 kilogrammes of liquid ammonia, and 60 kilogrammes of water to absorb it. Of course, none of the ammonia is to be lost: the gas can be driven from the solution and condensed again ready for another start. In the hot weather perhaps it might be arranged to let a puff into the omnibus to revive the fainting passengers. The idea is an excellent one, and I should be glad to see ammoniacal omnibuses started. But while they are being built I will, instead of sending a sealed packet to the Academy, publish a suggestion for M. Lenoir. Why should he not adapt his gas engine for locomotive purposes? I, for example, should like to drive my brougham, but I wish to be independent of coachmen who want wages, who get drunk and upset one, or at least steal one's corn and maltreat one's horses. I wish also to be independent of horses who will eat, and whose insane timidity or incorrigible vice is continually bringing their owners to grief. Well, why should I not start on my day's rounds with a bag of gas under my seat, and a battery outside, and be able to replenish my gas bag, as I refresh my horses, at a stand-pipe in the street? A gas engine is quite free from the objections which have been brought against steam engines for street traffic—no smoke, and no steam escaping with a loud noise to frighten the timid horses and scare the old women who throng our thoroughfares.

I think I have informed you before that two prizes have been founded by the Dollfus family, of Mulhouse, one of which is to be allotted every five years for the most useful invention, discovery, or application in science which has been made during the intervening years, of course in relation to the manufactures of Mulhouse. The first prize was allotted at the end of last year for aniline colours; but instead of one gold medal and 6000 francs, the money will be expended on five gold medals, one to Runge, the discoverer of aniline, and one each to MM. Bechamp, Perkin, Hofmann, and Verguin, the discoverer, investigators, and, in the case of M. Verguin, we may say one of the most successful practical manufacturers of the colours. Mr. Nicholson is not so well known as a scientific man here as in London.

The Sugar of the Future.

To the Editor of the Chemical News.

Sir,—On page 299, vol. x., of your valuable paper appears, under the rubric of Continental Science, a single word about a kind of sugar termed there, as the words used by my fellow-countryman and friend, Dr. J. E. de Vry, the sugar of the future. In reply to a note from me addressed to Dr. de Vry, I received the following letter, which I translate, and request you to insert it in your next impression, as it may contain some matter of interest to some of your readers. Dr. A. Adriani.

Dr. de Vry writes as follows:—"When, in the year 1857, I proceeded on my journey from Holland to Java, I stayed a month in Ceylon, and while there I became acquainted with the *Borassus flabelliformis*, vulgarly called by the Ceylonese-British inhabitants palm of Palmyra; and among other products of native industry my attention was called to the sugar sold by the natives under the name of *Jaggery*. The large number of the trees alluded to gave rise that, in conversation with parties in Ceylon, I uttered the idea of the possibility of applying the said palm trees, by regular cultivation, as a means of obtaining sugar on the large scale. As, however, my stay in Ceylon was only temporary, and as I, moreover, had neither time nor implements and apparatus for anything like a proper investigation, the matter was left at rest until, after having got settled in the interior of Java, my attention was aroused by the large quantity of sugar which is obtained by the Javanese inhabiting the Preanger Regentschappen from the Aren palm (*Arenga saccharifera*). It is true that the late Professor Reinwardt[*] had asserted that the juice of this kind of palm yielded a sweet material, but he had, as was perceived by me at once, erroneously stated that this was simply glucose; for I found that the sugar obtained by the natives in a very rude and primitive manner contains even yet then a large proportion of cane sugar." Dr. de Vry describes the mode of preparation of sugar from the Aren palm, as carried on by the Javanese, as follows:—"As soon as the palm commences blooming, a portion of the stem carrying the blossom is cut away; there exudes from the wound so made a juice containing sugar, which juice is collected in tubes made from bamboo-cane previously exposed to smoke, with the view of preventing the otherwise too rapidly proceeding fermentation of the juice under the joint influence of a warm climate, and the presence in the juice of a nitrogenous substance. The juice so obtained is immediately poured into shallow iron pans, heated by fire and inspissated by evaporation, until a drop of the liquid, exposed to cold by allowing it to fall on a cool surface, becomes solidified; if the desired degree of inspissation has been obtained, as evidenced by this experiment, the whole contents of the pan is cast into the shape of big cylindrical lozenges. Many thousands of pounds of sugar are annually obtained in this very primitive manner. I collected in a clean glass bottle a portion of the juice, and found that the unaltered juice does not contain any glucose at all, but it contains a nitrogenous principle which, aided by the warm climate, soon causes the conversion of a portion of the cane-sugar of the juice into glucose. In order to prove, without the aid of any very artificial means, that the juice of the Aren palm contains pure cane-sugar, I collected a portion of juice exuding from the tree, allowing it directly to flow into alcohol; by these means the nitrogenous principle alluded to is at once eliminated by coagulation. I thus obtained a mixture of equal parts of juice and alcohol; after filtration, this mixture was evaporated on a water-bath to the consistency of a syrup. This syrup I took along with me on my journey from Java home, and during the journey the concentrated syrup became solidi-

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[*] We shall translate this important memoir in full as soon as we receive it.—Ed. *C.N.*

[*] Dr. C. G. Reinwardt, late Professor of Botany and Chemistry of Leyden University, was, from 1816 to 1825 (nitallor), in Java to organise the scientific researches there to be made by botanists, geologists, &c., &c.

fied, exhibiting rare and beautifully well-defined crystals of cane-sugar, which, by every *connoisseur*, were immediately recognised. At the Congress at Giessen I have spoken about the manufacture of sugar from palm trees as the only rational mode of obtaining sugar in future, upon the following grounds:—Sugar, *per se*, consisting, as it does in a pure state, solely of carbon, hydrogen, and oxygen, does not withdraw from the soil anything, but the plants now-a-days mainly cultivated for obtaining sugar therefrom—viz., the *Beta vulgaris* and *Canna indica*—want for their growth a large proportion of substances from the soil in which they are grown for their sustenance; hence their culture impoverishes the soil. This, however, is not the least evil, for what is worse is, that the space now occupied by beet-roots in Europe, and by sugar-cane in the tropics, might and ought to serve for the growing of corn or fodder crops in Europe, and for growing rice under the tropics; and it is my opinion that, owing to the steady increase of population both in Europe and Asia, the time may not be far distant that it will be imperatively necessary to apply the space of ground now devoted to beet-root and sugar-cane to the cultivation of corn-crops and rice, in order to supply the increasing demand for these staple articles of consumption. Whereas sugar-cane and beet-root require such soils as are also adapted for cerealia, the Aren palm flourishes in soils utterly unfit for that purpose, so unfit even that it would be in vain to attempt to render such soils fit for the growing of rice or cerealia; the Aren palm relishes the deep mountain ravines of Java, running, in some parts of the island, from the sea-shore to the interior, the said palm being found in groups together; and it is quite possible to lay out fine plantations of this beautiful tree. There is one drawback, though not a very serious one, viz., not before the trees have obtained an age of from ten to twelve years are they fit to yield sugar. When, however, it yields sugar, the tapping can be continued for many years, and the sugar manufacture will become a continuous—not as now, an interrupted—industry. According to my calculation, a field of 500 square Rynland† roods planted with these trees, would yield annually 40 picols‡ of sugar from a soil quite unfit for any other kind of agricultural service. "I am, &c.

"Dr. J. E. de Vry."

MISCELLANEOUS.

Royal Institution.—The following are the arrangements for the ensuing week:—Monday, February 6, at 2 o'clock, General Monthly Meeting of Members. Tuesday and Thursday, February 7 and 9, at 3 o'clock, Professor Tyndall, F.R.S., "On Electricity." Friday, February 10, at 8 o'clock, W. G. Palgrave, Esq., "On Arabia." Saturday, February 11, at 3 o'clock, Professor Marshall, F.R.S., "On the Nervous System."

Artesian Wells. — It has been observed that Artesian wells can only be successfully bored where porous strata are intercalated between impermeable ones. Where the intercalation is often repeated, several distinct sources of water may supply a single well. In that at Bruck, near Erlangen, there are three such sources; in that at Dieppe, seven; whilst the well at Dulmen, in Westphalia, is supplied by no less than thirteen strata, in a depth of 380 feet. The great distance from which the water of an Artesian well may be derived was well shown by a boring near Tours, from which, when the borer was withdrawn, quantities of sand and small snail-shells were ejected, which must, without doubt, have found their way there from the mountains of Auvergne, thirty miles distant. A curious proof of the occasional direct communication of Artesian borings with superficial accumulations of water was given by wells of this description at Bochum in Westphalia, and Elbœuf in France, in the water from both of which eels and small fish have at times been found.—*Popular Science Review*.

Electro-plating.—In France electro-plating is regulated by law, every manufacturer being required to weigh each article when ready for plating in the presence of a comptroller appointed by the Government, and to report the same article for weighing again when the plating has been done. In this way the comptroller knows to the fraction of a grain the amount of the precious metal that has been added, and puts his mark upon the wares accordingly, so that every purchaser may know at a glance just what he is buying. As to the amount of silver consumed in ordinary plating: An ounce and a-half of silver will give to a surface a foot square a coating as thick as common writing-paper. And since silver is worth 5s. per ounce, the value of the silver covering a foot square would be about 7s. 6d. At this rate, a well-plated tea-pot or coffee-pot is plated at a cost in silver of not more than 7s. to 8s. The other expenses, including labour, would hardly be more than half that amount. Electro-gilding is done in like manner. The gold is dissolved in nitric-hydrochloric acid, washed with boiling nitric acid, and then digested with calcined magnesia. The gold is deposited in the form of an oxide, which, after being washed in boiling nitric acid, is dissolved in cyanide of potassium, in which solution the articles to be plated with gold, after due preparation, are placed. Iron, steel, lead, and some other metals that do not readily receive the gold deposit require to be slightly plated with copper. The positive plate of the battery must be of gold, the other plate of iron or copper. The process is the same as that above described. The popular notion is, that genuine electro-gilding must necessarily add a good deal to the cost of the article plated. This is erroneous. A silver thimble may be handsomely plated, so as to have the appearance of being all gold, for 3d., a pencil case for 10d., and a watch-case for 4s. An estimate of the relative value of electro-gilding, as compared with silver-plating, considering the cost of material alone, is about 15 to 1. The quantity of silver used in plating the ware sent in such large quantities to the colonies is about an ounce to the square mile; one hard cleaning exposes the base metal, and your bargain of plate from auction or that cheap store may be thrown on the dust-heap.—*Technologist*.

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publishers, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. *Private* letters for the Editor must be so marked.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. X. of the Chemical News, containing a copious Index, is now ready, price 11s. 0d., by post, 11s. 6d., handsomely bound in cloth gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. XI. commenced on January 6, 1865, and will be complete in 26 numbers.

G. C.—Liebig's last letter on the sewage question is a communication to the Corporation of London. It is being printed for circulation among the members of the Corporation, and as soon as it is issued no doubt most of the papers will reprint it. We shall give only a short abstract.

J. J. writes from Newport, Essex, that pigs seem to select coal for food, and that it is common in that part of the country to give them a few.

Received.—Mr. R. F. Smith; shall appear next week.

Book Received.—Le Substituant du Condenseur à Surface, &c. Par Emile Martin. Barthes and Lowell.

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† Equal to about three-quarters of an acre.

‡ One picol is equal to about 60 kilogrammes.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Preliminary Notes on Brochantite and Atacamite from Cornwall, by A. H. Church, *M.A., Professor of Chemistry, R. A. College, Cirencester.*

In the *Comptes Rendus* of November 28, 1864, M. Pisani gives a brief note on the occurrence of the mineral brochantite in Cornwall. He writes the formula of this species as deduced from his analysis thus,—

$$\dot{C}u_4\dddot{S}_3 + 3aq.$$

This, however, must be a misprint; there should be but one atom of SO_3, not three. The author does not give his analytical details, and his numbers do not indicate a very pure specimen. Having obtained, through the kindness of Mr. Richard Talling, of Lostwithiel, who originally detected this species in Cornwall, a supply of this cupric sulphate, I am able to announce that its analysis accords well with those previously published (of specimens from foreign localities), but I am led to propose a slightly modified formula as the best expression of my results. Reserving full analytical and other details for another occasion, I may briefly state that analyses gave the following percentages:—

$Cu_2\Theta$	69·00
$\bar{S}\Theta_3$	19·21
$H_2\Theta$	11·79
	100·00

The formula $Cu_2\bar{S}\Theta_4 + 5CuH\Theta$ demands these proportions:—

$Cu_2\Theta$	68·98
$\bar{S}\Theta_3$	19·85
$H_2\Theta$	11·17
	100·00

The accordance of these experimental and theoretical numbers is all that could be wished; while as to the construction of the new formula proposed, it may be compared, in chemical structure at least, with that of crystallised blue vitriol, as follows:—

Blue vitriol	$Cu_2\bar{S}\Theta_4 + 5H_2\Theta$
Brochantite	$Cu_2\bar{S}\Theta_4 + 5CuH\Theta$

The brochantite often accompanies Professor Maskelyne's new species "Langite," the latter mineral being then seen as a blue crust upon the dark green brochantite. The crystals in my specimens are too imperfect and confused for measurement. The matrix of the brochantite seems to be a decomposing slate, but immediately underlying the cupric mineral crust a considerable quantity of pulverulent ferric oxide occurs. Numerous special experiments have shown me that the Cornish mineral is truly brochantite, and not a new species. It may be added that wadd occasionally accompanies it.

Mr. Talling has also found another copper compound. This latter comes from the district of St. Just, and proves to be atacamite. It occurs in semi-crystalline crusts, in hollow stalactitic tubes, and in a variety of forms more or less distinctly stratified and rippled. The analytical details concerning this mineral are accumulating in my hands, and are nearly ready for publication; I believe I shall thus soon be able to elucidate the true constitution of this species. The proximity of the copper mine in which it is found to the sea, and the detection of sodium and magnesium salts in the atacamite itself, points to the manner of its formation. As may be expected, it is difficult to meet with really pure specimens.

Vol XI. No. 271.—February 10, 1865.

On Some Aluminium Compounds, by George Bowdler Buckton, *F.R.S., and* William Odling, *M.B., F.R.S.**

Until recently the molecule of aluminic chloride had always been represented by the formula Al_2Cl_3, or, selecting the high atomic weight of aluminium, as required by its specific heat, $AlCl_3$. But since Deville's determination of the vapour-densities of aluminic and ferric chlorides, many chemists of eminence, both in this country and abroad, have adopted the formula Al_2Cl_6, and have consistently doubled the previously-received formulæ for the entire series of aluminic compounds. In our opinion, however, the hitherto existing data seemed hardly sufficient for the definitive establishment of either set of formulæ; and it occurred to us that an examination of the so-called organo-compounds of aluminium might not improbably throw some important light upon the question at issue between them. We regarded the determination of the question as a matter of considerable interest from the bearing it would necessarily have upon the position of aluminium in a natural classification of the elements; upon the molecular formulæ of chromic, ferric, cuprous, and perhaps mercurous compounds; and, consequently, upon Laurent and Gerhardt's general law of even numbers. Moreover, a satisfactory investigation of the organo-compounds of a metal certainly not belonging to any one of the recognised classes of metals with whose organo-compounds chemists have become familiar, seemed likely to furnish a useful contribution to the common knowledge of organo-metallic bodies. Cahours, in an admirable paper on the organo-compounds of tin, published early in 1860, observed incidentally that aluminium was attacked by the iodides of methyl and ethyl at the temperatures 100°—130°, and that the crude ethylated product reacted violently with zinc-ethide to form a very inflammable liquid, which was doubtless aluminium ethide. Our experiments in confirmation of Cahour's results have been as yet merely preliminary, but by acting on aluminium with mercuric methide and ethide at the temperature of 100°, we have obtained pure aluminium methide and ethide without difficulty, and in not inconsiderable quantity. This mode of experiment was obviously suggested by Frankland and Duppa's recently described processes for making methide and ethide, and for transforming these compounds into zinc methide and zinc ethide respectively.

Aluminium Ethide.—Mercuric ethide with excess of aluminium-clippings contained in sealed tubes was heated for some hours in a water-bath, when the mercury was found completely displaced by the aluminium, thus, —$Al_2 + 3HgEt_2 = Hg_3 + 2AlEt_3$, or Al_2Et_6. After distillation off fresh aluminium and rectification in an atmosphere of hydrogen, the resulting aluminium ethide boiled steadily at 194°. It occurred as a colourless mobile liquid, which did not solidify at the temperature of — 18° C. It evolved dense white fumes on exposure to air, and when in thin layers took fire spontaneously, burning with a bluish red-edged flame, and producing an abundant smoke of alumina. On analysis it yielded 61·4 per cent. of carbon, 12·9 per cent. of hydrogen, and 24·0 per cent. of aluminium—numbers which accord reasonably well with the formula $AlEt_3$, or Al_2Et_6, the carbon and hydrogen being slightly deficient from some unavoidable oxidation of the substance analysed. Its vapour-density, taken by Gay-Lussac's process at the temperature 234°, was found to be 4·5, the theoretical density calculated for the formula $AlEt_3$ being 3·9, and

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* Abstract of paper read before the Royal Society.

that for the formula Al_2Et_6 being, of course, 7·8. Hence aluminium ethide would appear to have the simple molecular formula $AlEt_3$; for the difference between the experimental number 4·5 and the theoretical number 3·9, is an obviously necessary consequence of the extreme oxidisability of the compound. Water effected a complete decomposition of aluminium ethide with explosive violence. Iodine reacted upon it, to produce iodo-derivatives and iodide of ethyl. Oxygen in the form of dry air was simply absorbed with production of a body apparently analogous to boric di-oxyethide. But the iodo-derivatives and oxidation products have as yet been submitted to a preliminary examination only.

Aluminium Methide.—This compound was obtained by a process strictly analogous to that which yielded us aluminium ethide. On heating mercuric ethide with aluminium clippings in a water-bath, the replacement of the mercury by aluminium took place with even greater facility than manifested during the similar treatment of the ethylated body. After a single distillation, aluminium methide occurred as a colourless mobile liquid, boiling steadily at 130°, and solidifying a few degrees above 0° into a beautiful, transparent, crystalline mass. The liquid took fire spontaneously on exposure to air, burning with a very smoky flame, and producing abundant flocculi of alumina discoloured by soot. On analysis, aluminium methide gave 48·4 per cent. of carbon, 12·3 per cent. of hydrogen, and 38·2 per cent. aluminium, numbers which are quite sufficiently in accordance with the formula $AlMe_3$, or Al_2Me_6. Three separate determinations of vapour density, made at the temperatures of 240°, 220°, and 220°, the last with hydrogen in the tube, gave the numbers 2·80, 2·80, and 2·81 respectively, which agree closely with the theoretical number calculated for the formula $AlMe_3$—namely, 2·5. But the corrected density increased very rapidly with every decrease of temperature, a peculiarity of behaviour also noticed by Frankland in the case of boric methide. Thus, three separate determinations, made at 163°, 160°, and 162°, the last with hydrogen in the tube, gave the densities 4·1, 4·1, and 3·9 respectively; while the determinations made at the boiling-point of aluminium methide, of course with hydrogen in the tube, as recommended by Playfair and Wanklyn, gave the densities 4·36 and 4·40 respectively, which approximate somewhat to the theoretical density 5·0, calculated for the formula Al_2Me_6. Hence aluminium methide appears to be a member of that class of bodies whose vapour densities are, under certain circumstances, anomalous, either because the bodies exist in two molecular states of condensation, or because their vapours are not possessed of perfect elasticity until heated considerably above the boiling-points of the respective liquids. In either case the question naturally presents itself—May not the only observed vapour density of aluminic chloride correspond to the high vapour density of aluminium methide; and may they not both be equally anomalous, and consequently untrustworthy as a basis for determining the general formulæ of aluminic compounds?

The Cyanide from Blast Furnaces,

by ROBERT FRAZER SMITH.

IT has been long known that alkaline salts containing cyanogen are sometimes discharged from the neighbourhood of the tuyeres of iron furnaces using raw coal and the hot blast. In Percy's Metallurgy it is stated a Mr. Dawes in 1835 inserted in the specification of a patent for improvements in the manufacture of iron a claim for the collection of KCy from iron smelting furnaces by means of a pipe introduced into the furnace near the tuyeres. Zinken and Bromeis in 1842 published a notice of the occurrence of KCy in an iron smelting furnace at Mägdesprung, giving a qualitative analysis of the substance after it had been exposed to the air four months. Redlenbacher in 1843 published an account of its formation in quantity at an iron-smelting furnace in Styria; he stated it to have all the properties of a mixture of cyanide and cyanate of potassium. Bunsen aud Playfair in their celebrated report of the Alfreton experiments, found a large amount of cyanide daily produced in the furnace, but hitherto the presence of soda and lithia in the substance referred to has been overlooked.

One of the Portland iron furnaces near Kilmarnock having for some time produced from leaks in the neighbourhood of the tuyeres large quantities of a saline mass containing cyanogen, samples were frequently procured, and the amount of cyanogen estimated. Some of the specimens were of great beauty, being invariably pure white mottled with pink-coloured veins, probably owing to manganic oxide. One botryoidal mass produced weighed upwards of 50 lbs., and was secured by Mr. Borland, a member of the Pharmaceutical Society, in order to send it to the Pharmaceutical Museum in London, but unfortunately it had been exposed to the too long at the furnace and had become deliquesced. The cyanide not only escaped from the furnace in the fused state, but was present as well in the air within a distance of some feet of it, and could be recognised perfectly well by the odour, and by its settling down in powder on cold surfaces held near the orifice. None of the other furnaces produced it, and the one in question on being blown out and repaired, has also ceased to yield the cyanide, and from inquiries made among the workmen it seems that it is never seen except when a furnace is old and leaky, It occurred to me to test this substance for lithia; accordingly every sample that could be procured was examined with the spectroscope, and in every case the lithium band was seen. On converting the substance into chlorides, and using a mixture of absolute alcohol and anhydrous ether, the chloride of lithium was easily found in comparative quantity. The amount of lithia in three different samples was ascertained by the method of Mayer, recommended by Dr. Miller in his analysis of the Wheal Clifford Spring, and amounted respectively to ·29, ·31, and ·74 per cent. The question arises is the lithia derived from the coal, the limestone, or the ore? I have failed in obtaining any trace of its presence from any of them, but I am still endeavouring to find it in the coal, which has probably been the source of it.

The following is a careful analysis of one of the samples obtained fresh from the orifice, in order to show its composition; all the specimens contained the same ingredients, though varying of course very much in their proportions to each other:—

Cyanate of potassium	21·45
Carbonate ,,	1·34
Silicate ,,	·98
Sulphate ,,	·41
Cyanide ,,	47·73
Sulphide ,,	1·61
Chloride ,,	·74
Potassa	10·13
Soda	7·19
Lithia	·74
Graphite	4·50
Insoluble residue fixed at low red heat	1·32
	98·14

The soluble salts did not contain a trace of iron or lime. Ferrocyanogen was likewise absent, but the residue insoluble in water contained silicic acid, lime, alumina, and ferric oxide.

Phosphoric acid was tested for, but no trace of it could be detected with 60 grammes of substance. The graphite was not mere charcoal powder, but possessed all the characteristics of carbon in the graphoidal condition. In six samples the cyanogen varied from 3 to 19 per cent.

Kilmarnock, January 30.

TECHNICAL CHEMISTRY.

Use of Petroleum or Mineral Oil as Steam Fuel in Place of Coal, by B. H. PAUL.

THIS subject continues to excite so much interest among those connected with steam navigation, and the statements which have been made by those who propose by means of petroleum or coal oil to effect a reorganisation of our naval and mercantile marine are so totally irreconcileable with all known principles relating to the application of fuel, that it will not be superfluous to illustrate this fact by reference to the opinions expressed and to the arguments used by several of the speakers in a recent discussion of the subject at the United Service Institution. Such a course is the more admissible since many who appreciate the importance of any mode of improving or economising the use of fuel confess their inability to judge as to the merits of this project, and express themselves desirous of information.

The data which I have already referred to in this journal,* for the purpose of showing that the substitution of petroleum for coal as fuel is impracticable, are not disputed. On the contrary, they are adopted by those who advocate this change. But, at the same time, they urge that those data relate only to a theoretical consideration of the subject, and are therefore not to be taken as deciding the practical question as to the relative fuel value of petroleum and of coal. In this opinion I quite concur, but it must be remembered that no means of arriving at a practical solution of this question have yet been afforded. It was only from the want of such positive data, expressing results obtained with petroleum and with coal, as would enable an engineer or any one else to form an opinion as to the comparative values of these materials as fuel for steam vessels, that I was constrained to have recourse to the only accessible criterion by which an opinion could be formed as to the representations which have been made. The comparison of the utmost effects capable of being produced by petroleum and by coal under the most favourable conditions is perfectly valid so far as it applies; but I must admit that it would have been far more satisfactory to have been able to base my opinion on the results of trustworthy experiments made with the object of ascertaining the actual duty obtained with the two materials, and I cannot refrain from expressing my surprise that statements so extraordinary as those I have referred to should have been put forward ostensibly as the result of experiments in the Government dockyard, with the apparent authority they thus acquire, and without a vestige of practical evidence in support of them. Mr. Richardson has publicly declared that forty-two gallons of oil equal one ton of coal in steam-producing power. He admits that this requires proof, and he has promised that it shall be proved;† but as yet the proof has not been furnished, nor was any approach made towards it in the papers read at the United Service Institution on the 16th inst. It rests, therefore, with the advocates for the use of petroleum to remove the cause of the objection they made to the comparison between that material and coal upon theoretical grounds.

But their chief argument in favour of petroleum is that this material can be used as fuel so that its capability may be rendered effective to a much greater proportion than is possible in the case of coal. Here, again, we are without any evidence of a practical nature in support of this proposition. No doubt it is a well-established fact that different kinds of fuel do not always admit of equal effects being produced in generating steam, although their heating capability or calorific power may be the same. It is upon this ground that the advocates of petroleum take their stand, and Mr. Richardson states that, while one-half of the coal consumed in a marine boiler furnace disappears and is lost as soot and smoke, the heating capability of petroleum is fully utilised.‡ If this were admitted, we should still be far from attaining that advantage from the use of petroleum in place of coal which Mr. Richardson represents by stating that one ton of petroleum equal five tons of coal, for since the calorific power of petroleum is to that of coal as 1·5 : 1, it follows that by fully realising the calorific power of petroleum and realising only half that of coal the practical effects of these materials would be in the ratio of 3 : 1, not as 5 : 1, which upon the same supposition would require the calorific power of petroleum to be 2·5 as compared with that of coal = 1·0. There is therefore some error in this; but without attempting to ascertain in what it consists, it will be more useful to inquire how far there may be—in the absence of those special data which are so much needed—any means of instituting a practical comparison between coal and petroleum in regard to the possibility of using the latter more advantageously than coal as fuel in a marine boiler furnace.

It is well known that no kind of fuel is burnt under ordinary circumstances so as to realise the whole of the heating effect it may be capable of producing. Therefore, the true practical comparison between different kinds of fuel as regards their value consists in ascertaining not only what they respectively can do, but more especially what they really do. The actual work done by fuel depends partly upon its nature, partly also upon the kind of effect to be produced. When an intense degree of heat, or very high temperature is required, as in smelting iron, the heating capability really utilised is not a tithe of that which is utilised when fuel is burnt for generating steam, and still less than that utilised when fuel is burnt in a common domestic grate.

But even in the generation of steam different kinds of fuel give different results, and under the very unfavourable conditions which obtain in a marine-boiler furnace, experience has shown that there is a great difference in the duty or effects produced by equal quantities of different coal possessing equal heating capabilities. Hence the recognised practical superiority of Welsh steam coal over the more bituminous kinds of coal represented by the North country coal.

Now, what is the difference between these two kinds of coal to which their different value as steam fuel is referable? It is simply this, the Welsh coal is almost

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* Chemical News, December 17, 1864, page 291.

† *Mining Journal*, December 24, 1864, page 890.

‡ See *Times*, December 14, 1864, page 7.

entirely fixed, approximating in this respect to pure carbon; it does not give out much combustible gas when heated, but it burns almost entirely within the furnace, and unless the rate of combustion be very rapid, it burns completely, generating its full equivalent of heat, which is transferred through the medium of the combustion products to the water in the boilers. The amount of heat generated by the combustion of the best Welsh coal is equivalent to the production of nearly 15 lbs. of steam from water at 212°F. for each pound of the coal completely burnt. Of course this duty is never realised in practice, because the water has to be heated to the boiling point, and because the whole of the heat generated cannot be transferred to the water in the boiler, great part of it escaping in the combustion products. But the approximation to that theoretical duty will be greater in proportion to the perfect combustion of the coal, and to the absence of soot or smoke production. For every pound of soot or smoke produced, the possibility of generating at least seven pounds of steam will be lost, and the duty of the coal will be proportionately reduced.

The calorific power of the best bituminous coal is not appreciably less than that of Welsh steam coal, but it contains from 30 to 40 per cent. of volatilisable substance, and consequently when heated combustible gas or vapour is evolved to that extent. This gas or vapour, amounting to something like 300 times the volume of the coal from which it is produced, mixes with the combustion products, and is thereby rendered less readily combustible. Under the influence of the draught, and by reason of its great bulk and mobility, it is drawn out of the furnace before it can be burnt, and passing into the tubes of the boiler the combustion is stopped partly by the cooling of the gas, and partly by the want of air, so that instead of generating its equivalent of heat, it produces soot and smoke.

This action takes place to some extent with all coals, especially when it is burnt under the unfavourable conditions obtaining in a marine-boiler furnace, and it was the disregard of this circumstance which vitiated the results of the long and costly experiments made some years ago by Dr. Lyon Playfair, with the view of ascertaining the relative value of different kinds of coal as fuel. But in regard to steam navigation the relative values of different coals are determined by the degree to which this action takes place. The more a coal is capable of being burnt within the furnace, the better it is for that purpose. The greater the amount of volatilisable substance it contains, the less suitable it is, and the greater the extent to which production of soot and smoke is substituted for the production of heat. These being correlative results, it follows that the fitness of coal for steam navigation is inversely proportionate to the amount of volatilisable substance it contains. It is for this reason that while the duty obtained with Welsh coal sometimes exceeds 10 lbs. of steam per pound of coal burnt, that obtained with Newcastle coal is often as low as 6 or 7 lbs.

Applying this result of long experience to the case of petroleum as compared with coal, the conclusion to which it leads is even more disadvantageous for the former than the comparison already made on the ground of calorific power and cost.§ For petroleum is altogether volatilisable, and is, consequently, peculiarly liable to produce soot and smoke when burnt even slowly, and without any of those disadvantages to which it would be subject in the furnace of a marine-boiler. Indeed, it appears to me that nothing can be more incompatible with the use of petroleum as fuel than the conditions which obtain in that case. No doubt it may be urged in answer to this that the introduction of a peculiar boiler is contemplated; but nothing need be said as to that contingency until the superiority of petroleum over coal shall have been satisfactorily made out.

The objection I have urged to the use of petroleum on the score of cost has been answered by Captain Selwyn, who suggests that the price of petroleum ought to be reduced if it came to be used as fuel, and that if it were not he believes a material almost identical with it may be obtained from coal at a lower cost—9*l.* or 10*l.* per ton. So far as the price of petroleum is concerned, I am disposed to consider any anticipation of a reduction as being extremely delusive, and the lower cost of coal oil would still leave it at a great disadvantage as compared with coal.

But if Captain Selwyn, before assuming the part of a protecting ægis to a deluded inventor, had applied to his own conceptions that simple axiom that "a whole is greater than its part," he would probably have seen a little more clearly the value of the whole project of reorganisation which it is proposed to carry out in relation to steam navigation. Thus, for instance, the very richest oil-yielding coal known—the Leeswood cannel—yields about one-third its weight of oil. In producing a ton of oil from three tons of this coal, a considerable quantity of combustible gas, capable of generating a large quantity of heat, is lost, and there remains greater part of the carbon of the coal in the state of coke, amounting to more than one ton. Both the gas and the coke are of value as fuel, so that the real fuel-value of the oil from three tons of coal is, in fact, equal to the total fuel-value of that quantity of coal *minus* the fuel-value of the coke and gas. But according to the representations made in favour of substituting coal-oil for coal as fuel, one ton of oil is to do the work of five tons of coal; so that, according to this view, the fraction of the heating power belonging to the three tons of coal will be equal to the heating power of five tons of coal!! This is equivalent to the proposition that part of three is equal to five, an absurdity so glaring that it is truly wonderful that it should have escaped recognition even by an inventor.

The signal misconception which characterises the views of those who advocate the substitution of petroleum for coal in steam navigation was illustrated in an almost equal degree during the discussion following the papers read by Captain Selwyn and Mr. Richardson at the United Service Institution. Thus, for example, Sir Edward Belcher referred to the oxyhydrogen flames as proving the fuel-value of hydrogen to be much greater than that of carbon or of coal. Nothing could possibly be more irrelevant, and it can only be inferred that Sir Edward Belcher is not aware that the thermal efficacy of the oxyhydrogen flame is solely due to the fact that oxygen gas is used in the place of air for the combustion. This circumstance alone places the oxyhydrogen flame beyond the range of a practical consideration of the subject; but so far as a comparison can be instituted between hydrogen and carbon when burnt with oxygen, the fact is that the thermal effect or temperature produced by carbon under that condition is far greater than that produced by an equal weight of hydrogen; these effects being in the ratio of about 10 : 7. When those substances are burnt in air, the difference in thermal effect is inappreciable. So far as the possible evaporative effect is concerned, the difference between petroleum and coal, in

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§ See Chemical News, December 17, 1864, page 292.

the amount of hydrogen they contain, is not so great as to have a very great influence; and since an increase in the amount of hydrogen in fuel is accompanied by increased liability to produce smoke and soot, it would, under existing circumstances, be rather a disadvantage than otherwise. Captain Selwyn's reference to the common fishtail gas burner used for illuminating purposes, and to the Bunsen burner used in laboratories for heatings, as being illustrative of the different effects obtainable by burning combustible substances under different conditions, was equally infelicitous, and indicated an equal ignorance of the most rudimentary principles affecting the use of fuel; for in the flame of the fishtail burner and in that of the Bunsen burner the heating effects produced are equal for equal quantities of gas burnt, and the thermal effects or temperatures produced are probably little, if at all, different. Both these gentlemen appear to be very much "at sea" in their notions respecting fuel and its applications.

The view of this subject which is put forward in the above remarks will doubtless appear to many extremely trite and self-evident; but the fact that it is not so to every one interested in the use of fuel may perhaps be a sufficient excuse for stating it so fully, and the still more remarkable fact that some who have held such a view have been induced to abandon it, and to express themselves satisfied with the astonishing statements made as to the effects of petroleum when used as fuel, will show what strange results may be produced by vigorous assertion even of the most palpable absurdities. In fact, the whole of the arguments brought forward by those who contemplate effecting the entire reorganisation of our navy, and of steam navigation, indicate a woeful deficiency of acquaintance with the subject, and well illustrate the proverbial danger of a "little knowledge."

There is, however, still room to hope that, by having recourse to that practical mode of deciding any question there may be in their minds as to the relative values of coal and petroleum, which I fully agree with them in thinking the only satisfactory test, and which is unfortunately a great desideratum in the present case, they will arrive at such a state of disillusion as will permit them to make a more useful application of their ingenuity.

On Aniline Black,* *by M.* LAUTH.

ANILINE black is a new coloured derivative of aniline, which, so to say, completes the series of brilliant colours derived from this base. It differs, however, in many respects from the other coloured derivatives. The mode of production, the way of fixing it on fabrics, and the insensibility to physical and chemical agents which it presents, are points on which it differs essentially from the red, blue, and violet of aniline.

Mr. Lightfoot's process, which the author quotes, is well known to our readers, and we shall only quote from this paper the author's new process for aniline black, which, it will be seen, and, indeed, is admitted to be, but a simple modification of Mr. Lightfoot's.

M. Lauth's process consists in printing with the mixture of hydrochlorate of aniline and chlorate of potassium an insoluble oxidisable salt, which will become soluble on the fabric—sulphide of copper, for example. By the oxidising action of the chloric acid (or the chlorine which is set free by the reaction of hydrochlorate of aniline on chlorate of potassium), the sulphide of copper is transformed into sulphate.

In this same process some of the disadvantages of Mr. Lightfoot's process are avoided. It is a more economical, the mixture does not act on the steel rollers, nor does it weaken the fabric—not more, at all events, than madder black. The colour is very permanent, and is fixed at from 20° to 40° C. Its composition allows of its being printed with all sorts of colours.

Aniline black has a specially beautiful appearance; it has a very rich black velvety look. It is completely insoluble in water, alkaline or acid, and is not affected by soap. Acids change the black to green, but the original colour is restored by an alkali. Bichromate of potash deepens the shade, but a very strong solution slightly reddens it. Strong chloride of lime bleaches it, but the colour returns after a time.

M. Lauth promises another and further account of aniline black in a short time.

Removal of Bisulphide of Carbon from Gas.

MR. LEWIS THOMPSON has published† a very simple process for purifying gas from bisulphide of carbon. It is based on the fact that the bisulphide and the vapour of water cannot exist together at a red heat, mutual decomposition taking place with the formation of sulphuretted hydrogen and carbonic acid.

$$CS_2 + 2HO = 2HS + CO_2.$$

The removal is carried out practically by mixing the gas as soon as it leaves the hydraulic main with a certain proportion of steam, and carrying the mixture through a tube heated to a fully cherry red. The length of this tube must be proportioned to the velocity of the current, so that there may be time for the whole of the mixture to become heated. The products of the reaction are, of course, removed by the ordinary methods of purification. Gas from ordinary coal so treated does not, according to Mr. Thompson, have its illuminating power diminished by the treatment.

PHYSICAL SCIENCE.

On the Invisible Radiation of the Electric Light, *by* JOHN TYNDALL, *F.R.S.*‡

PENDING the preparation of my complete memoir, which may occupy me for some time to come, I would ask permission of the Royal Society to lay before the fellows a brief and partial summary of the results of my experiments on the invisible radiation of the electric light.

The distribution of heat in the spectrum of the electric light was examined by means of the linear thermo-electric pile, applied to the solar spectrum by Melloni, Franz, Müller, and others. The electric spectrum was formed by lenses and prisms of pure rock-salt, its width being equal to the length of the row of elements forming the pile. The latter, standing at right angles to the length of the spectrum, was caused to pass through its various colours in succession, and to search the spaces beyond the region of colour in both directions.

As in the case of the solar spectrum, the heat was found to augment from the violet to the red, while the maximum heating effect was observed beyond the red, and at a distance from the red, in one direction, equal to that of the green of the spectrum in the other.

The augmentation of temperature beyond the red in

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* Abridged from the *Moniteur Scientifique*, January 15, 1865.

† Newton's *London Journal of Arts*, February, 1865.

‡ Abstract of paper read before the Royal Society.

the case of the electric light is sudden and enormous. Plotting from a datum line the thermal intensity of the various portions of the spectrum, the ordinates suddenly increase in length beyond the red, reach a maximum, and then fall somewhat more suddenly on the other side. When the ends of the ordinates are united, the curve beyond the red rises in a steep and massive peak, which quite dwarfs the luminous portion of the spectrum.

The comparative height and steepness of this peak are much greater than those obtained by Professor Müller for the solar spectrum. Aqueous vapour acts powerfully upon the invisible rays, and, doubtless, the action of this substance in our atmosphere has toned down the eminence beyond the red in Professor Müller's diagram. A solar spectrum, produced beyond the limits of the atmosphere, would probably exhibit as steep a peak as that of the electric light.

In the experiments now to be referred to, the rays from the electric light were converged by a small concave mirror. The glass mirror silvered at the back, which usually accompanies the camera of Duboscq's electric lamp, was one of the first employed. It was brought so near the electric light as to cast an image of the coal-points five or six inches in advance of the light. A solution of iodine in bisulphide of carbon, contained in a rock-salt cell, was then placed in front of the lamp: the light was thereby cut off, but the focus of dark rays remained, and various effects of combustion and incandescence were obtained at the focus. A mirror four inches in diameter, and silvered in front, will enable an experimenter to obtain most, if not all the results now to be mentioned. I also employ a mirror eight inches in diameter, and having a focal length of eight inches, with excellent effect.

It is not necessary to enclose the opaque solution in a rock-salt cell. The vessel intended for a solution of alum, which usually accompanies the lamp of Duboscq, and the sides of which are of glass, answers admirably. It is not, however, quite deep enough for the several tests to which I have subjected it, and in crucial experiments I employ a deeper vessel with rock-salt sides.

With the eight-inch mirror just referred to behind the electric light, the opaque solution in front, and the focus of invisible rays about six inches distant from the electric light, the following effects have been obtained:

1. Wood, painted black, when brought into the dark focus emits copious volumes of smoke, and is soon kindled at the two spots on which the images of the two coal-points fall.

2. A piece of brown paper placed near the focus soon shows a burning surface, which spreads over a considerable space, the paper finally bursting into flame.

3. Black paper brought into the focus is immediately inflamed.

4. The wood of a hat-box similarly placed is rapidly burnt through, and usually bursts into flame.

5. The end of a cigar, placed at the dark focus, is instantly ignited.

6. Disks of charred paper placed in the focus are raised to brilliant incandescence, surfaces of considerable extent being brought to a vivid glow. Charcoal is also ignited.

7. A piece of charcoal, suspended in a receiver of oxygen, is ignited in the dark focus and caused to burn brilliantly, the rays after crossing the glass of the receiver being still sufficiently powerful to heat the coal up to incandescence.

8. A mixture of oxygen and hydrogen is exploded in the dark focus by the ignition of its envelope.

9. A piece of zinc-foil, blackened on one side to diminish reflection, is pierced and inflamed. By gradually drawing the strip, once inflamed, across the focus, it may be kept blazing for a considerable length of time. This is a particularly beautiful experiment.

10. Magnesium wire, presented suitably to the focus, burns with its intensely luminous flame.

In all these cases the effect was due, in part, to chemical action; this, however, may be excluded.

11. A plate of any refractory metal, sufficiently thin, and with its reflective power suitably diminished, is raised to incandescence in the dark focus. Gold, silver, copper, aluminium, and platinum have been thus rendered incandescent.

12. Platinised platinum shows the effect best; in a thin leaf it may be rendered white-hot, and on it is depicted an incandescent image of the coal points. When the points are drawn apart, or caused to approach each other, their incandescent images conform to their motion.

The assemblage of phenomena here described, and others to be referred to in my completed memoirs, may, I think, be properly expressed by the term "calorescence." This word involves no hypothesis, and it harmonises well with the term fluorescence, now universally employed with reference to the more refrangible end of the spectrum.[§]

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, February 2.

On this occasion the meeting was held, by the special invitation of the Council, in the lecture theatre of the Royal College of Chemistry. There was a very large attendance of members, and Professor A. W. Williamson, Ph.D., F.R.S., President, occupied the chair.

The proceedings were commenced by reading the minutes and balloting for the election of the following gentlemen, viz.—Mr. Charles Eastcourt, Manchester; Mr. Arthur Vacher, 29, Parliament Street, London; Mr. Francis Walker, Sidney College, Cambridge; Mr. John Reid, Trinity College, Cambridge; Mr. Thomas P. Blunt, B.A., Shrewsbury; Mr. Robert H. M. Bosanquet, Oxford; Mr. Nathaniel Bradley, Prescot, Lancashire; Mr. Richard Percival, University of Glasgow; Mr. Arthur Smith, Loughborough Road, Brixton; and Mr. Thomas Heathcote Windham. These several candidates were declared to be duly elected Fellows of the Society.

The President then called upon Professor Hofmann to favour the Society with an account of the *Lecture Illustrations* which he had apparently taken so much trouble to prepare for them on this occasion.

Dr. Hofmann said the present aspect of chemical science might be fitly compared with a field of battle immediately after a decisive engagement, when the vanquished squadrons, for a time dispersed, were again rallying for a renewed attack. The picture of confusion which supervened was suggestive of the state of difficulty and doubt

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[§] On December 5 last I tried the passage of the rays from the electric lamp through a great number of different coloured glasses. Incandescence was obtained through almost all of them; and in one instance, the radiation passing through a blue glass, the thermograph of the coal points was of a pink colour. A thick black glass, obtained from Mr. Ludd, when held in front of the lamp, was found to be not perfectly opaque, still the platinum could not be raised to incandescence at all when placed in the focus. Being called away from the Royal Institution early in the afternoon, I gave directions to my assistant, Mr. Barrett, to continue the experiments. He informs me that on placing in the path of the rays a combination of two thin plates of black glass, one transmitting a whitish-green and the other a deep red, the light was entirely intercepted and feeble, though distinct incandescence was obtained at the focus. With radiation through the solution of iodine, the thermograph on this day rose to a white heat.

which necessarily accompanied a great revolution, and before the new rule in chemistry was generally acknowledged, there must be a period of perplexity, both to the student and professor. In his intercourse with students such phrases of explanation or inquiry as "old style," "new style," "newest style," "little or big equivalents," &c., were of common occurrence; but although these disputed points might for a time give rise to some little inconvenience in the ordinary teaching of the science, they were but trifling difficulties in the way of the glorious consummation of the revolution which he trusted was near at hand. For the new theory, the speaker claimed advantages on the score of greater simplicity and precision; at the same time, it was more practically useful and suggestive. There could be no doubt that it was increasing in favour, and many of his friends now present had already adopted it. He hoped that Dr. Odling, who had already done much to help the cause, would shortly find leisure to complete his treatise which bids fair to become the text book of the science under its new aspect. Dr. Miller also had taken up the question with extraordinary vigour, and the capital work of Mr. Watts was worthy of particular mention. Still much remained to be done before the newly-acquired views could be elaborated into a methodical system of teaching chemistry. It could not be denied that we had to break with many of the classical traditions of chemical instruction. He did not allude to the necessity of acquiring the habit of calling water H_2O, instead of HO, or marsh gas CH_4 instead of CH_2, but to the radical change which had to be introduced into the general system of teaching, to the choice of subjects prominently to be brought forward, and more especially to the form and style of illustration adapted to the elucidation of these subjects. The Chemical Society includes among its members many professors of chemistry, and the speaker desired to promote an interchange of experience among his colleagues; in fact, the present statements had emanated more particularly from a conversation with Dr. Miller upon the best means of illustrating particular facts, which were no doubt capable of demonstration, but had usually been taken for granted in their course of lectures.

It was one of the delightful prerogatives of chemical teachers that they were enabled to survey their subject from a great variety of points of view, but whatever plan might be adopted in future teaching, he could scarcely doubt that far greater prominence would be given to those four typical hydrogen compounds, hydrochloric acid, water, ammonia, and marsh gas, which might be called the four corner stones of the modern structure of chemistry. For three or four years past he had been in the habit of inaugurating his annual course with a series of eight or ten lectures on these typical bodies.

In attempting the experimental demonstration of the composition of these bodies the lecturer said he had met with certain difficulties; some of these failures he thought should be recorded, so as to avoid loss of time on the part of others working in the same direction, thus in the electrolysis of hydrochloric acid performed in the ordinary manner, but under a great variety of circumstances, he found it practically impossible to obtain equal volumes of hydrogen and chlorine, and if the gases were evolved under pressure, the apparatus being surrounded with hot water so as to diminish the solubility of the last-named gas, the platinum poles were very quickly dissolved. The synthesis of hydrochloric acid from given volumes of chlorine and hydrogen was next attempted in the following manner:—A glass tube, both extremities of which could be closed by small glass stopcocks, was filled with dry chlorine gas, and then placed in communication with a U-tube containing an equal volume of dry hydrogen confined by means of a column of mercury; then, the stopcocks being opened, the electric discharge from a Ruhmkorff coil was passed across the point of junction of the two tubes, and a series of small explosions occurred; but never was the combination perfectly effected, small quantities of the hydrogen and chlorine refused to combine, and the final product was not therefore perfectly absorbed by water when the tube was removed and afterwards opened under the liquid. In the French, and also in some of the German, manuals of chemistry was to be found a very nice woodcut illustrating an arrangement of apparatus for showing the decomposition of hydrochloric acid gas by means of a pellet of potassium or sodium in a bent glass tube standing over a mercurial trough. His friends would recognise, in the sketch on the board, the "*cloche courbe*" of the French chemists; but could any one inform him how a potassium pellet free from oxide was to be got through the mercury into the tube? On making the same inquiry of a celebrated French professor, he replied —"*C'est une des experiences qu'on ne fait pas.*" The lecturer then proceeded to show an experiment whereby the composition of hydrochloric acid was easily demonstrated. A glass U-tube, having one extremity perfectly closed and the other provided with a stopper, was filled nearly to the bend with dry hydrochloric gas over mercury; the volume was accurately registered by an india-rubber ring after the level of the mercury had been equalised in both limbs of the tube, the excess of metal being allowed to flow out at a supplementary aperture placed near the bend. This aperture having been again closed by a pinch-cock, a long funnel was introduced and the remaining space of the open limb filled with a quantity of freshly-made sodium amalgam, the stopper was firmly adjusted, and the gas transferred to this limb of the tube and made to pass several times through the sodium amalgam. When the absorption of chlorine was judged to be completely effected, the remaining gas, hydrogen, was returned to the original position and measured, after equalisation of the mercury level, as before. The constituent was now found to occupy exactly half the volume of the hydrochloric acid experimented upon; the difficulty with the *cloche courbe* was thus overcome. It was requisite to prove, in the next place, that one volume of chlorine was united with one volume of hydrogen without condensation; this could easily be done by making use of a modified electrolytic apparatus, whereby, with two cells of Bunsen's battery, the mixed gases evolved from a small bulk of liquid hydrochloric acid were collected in long glass tubes, which were then sealed at the ends. If the extremity of one of these tubes was broken off whilst immersed in an outer cylinder of water coloured by logwood, the liquid entered, a bleaching action was apparent, and the tube filled to the extent of one-half. Lastly, by breaking off the upper extremity and depressing the tube, the hydrogen rushed out and could be inflamed. Dr. Hofmann stated that he kept always on hand a number of such tubes filled with hydrogen and chlorine; they might be preserved for any length of time in blackened tin cases. The lecturer then exhibited the mode of inducing the combination of the mixed gases by exposing one of the tubes to the blue flame of bisulphide of carbon burning in nitric oxide. The ends were for this experiment strengthened by external glass tubes cemented on with sealing-wax. After the combination had been effected, the volume of gas remained constant, which was shown by opening under mercury; the tube was then transferred to the deep cylinder of coloured water as before, and very quickly became entirely filled with the liquid. Thus it had been perfectly demonstrated that "two volumes of the constituents produced two volumes of the compound."

Passing now to the history of water, the lecturer showed a new apparatus for the electrolysis of this liquid which permitted of the collection of the gases separately, of noting their comparative volumes, and afterwards of identifying the gaseous constituents by a lighted match. It simply consisted of a long U tube, the shorter limb of which was subdivided into a fork, wherein the oxygen and hydrogen were to be collected separately, the gases being disengaged from platinum wires sealed within the tubes and externally connected with the battery; the upper extremities of the tubes were closed by glass stop-cocks, for the purpose of facilitating the examination of the gases. During the disengagement of the hydrogen and oxygen, a considerable column of liquid had risen in the tall limb, so that the two gases were under moderate pressure. Upon opening the stop-cock of the tube containing oxygen, a jet of the gas issued forth and rekindled a glowing match, which then was held over the hydrogen jet, and this gas allowed to become inflamed. Dr. Hofmann then showed a lecture experiment which demonstrated the fact that two volumes of hydrogen and one volume of oxygen become condensed to two volumes of aqueous vapour in the act of combination. A bulk of the mixed gases was confined in the closed limb of a U-tube, similar to the one used in the analysis of hydrochloric acid, over mercury, and then surrounded by an outer tube through which the vapour of boiling amylic alcohol (about 130°C.) was constantly passing. The gas was then accurately measured; the electric spark having been transmitted, an explosion ensued, and the resulting compound occupied but two-thirds of the original volume of its gaseous constituents.

With respect to the constitution of ammonia, the lecturer first showed that by passing the discharge from a Ruhmkorff coil through ammonia gas confined in a U-tube by a column of mercury, the compound became resolved into a mixture of its gaseous constituents which then occupied a double volume. The crowning experiment was, however, that which demonstrated the proportion of nitrogen existing in ammonia. A long tube, having its linear dimension divided into three equal parts by india-rubber rings, was filled with chlorine over the pneumatic trough, and to its open extremity was quickly adapted a small glass globe, containing strong ammonia. On opening the stop-cock, a few drops of liquid entered, which immediately gave rise to a brilliant flash of light; then more ammonia was introduced, and the liquid slightly warmed, to complete the decomposition and ensure the destruction of any trace of chloride of nitrogen. The ammonia remaining in the little globe was then exchanged for dilute sulphuric acid, and a bent tube, dipping into a larger quantity of the same liquid, was placed in communication. The stop-cock being again opened, the fluid entered and quickly occupied exactly two-thirds of the tube, leaving one-third of pure nitrogen. Knowing already that chlorine induces the absorption of a volume of hydrogen equal to itself, it had thus been demonstrated that hydrogen unites with nitrogen in the proportion of three to one when forming ammonia. Dr. Hofmann said that his experiments with marsh gas—the last of the series of typical compounds—had not been attended with equal success; and he ventured now to appeal to his colleagues for their advice and suggestions. Marsh gas doubled its volume under the influence of the electric spark; but the results were slightly erratic. The disposition of the carbon to form a bridge of communication between the poles could be overcome by occasionally reversing the direction of the current. At present, however, the lecturer was not prepared to show any good analytical proof of the composition of marsh gas.

The lecturer was ably assisted in the experiments by Mr. McLeod, and the whole subject appeared to possess great interest for the audience.

The President said that, owing to the lateness of the hour, he could scarcely invite them to discuss the experiments which had been brought under their notice; but moved a vote of thanks to Dr. Hofmann, which was warmly responded to, and commented upon the importance of placing before the student certain leading experiments, such as those they had just witnessed, by which the constitution by volume of a number of typical compounds was made manifest to them at the commencement of a course of lectures.

The titles of several papers were announced, and the meeting was then adjourned until the 16th instant.

PHARMACEUTICAL MEETING.

Wednesday, February 1.

Mr. Hills, *Vice-President, in the Chair.*

The first paper read was "*On the Kola-nut of Tropical West Africa*" (the Guree-nut of Soudan), by Dr. W. F. Daniell, F.L.S. The seeds of the cola tree (*cola acuminata* R. Br.), said the author, have been from time immemorial an important article of commerce among the natives of Central and Western Africa, and are to be found also in the markets of Fez, Tripoli, and other mercantile depôts on the Mediterranean. The Portuguese merchants have always accepted the statement of the natives that the nuts are a luxury reserved for the chiefs and richer classes of natives, and are merely used as a means of rendering water pure and palatable; and thus never dreamt of the seeds containing a highly nitrogenised body. But the circumstance that all who can procure the nuts indulge in chewing them all day long, might have suggested that they contained something of much value, if not of actual necessity, in a country where animal food is scarce, and often difficult to procure. Dr. Daniell then proceeded to give an interesting account of the uses of the seed in aboriginal customs. It seems that when a trader visits a chief, the present of a few seeds from the latter conveys an assurance of welcome and protection. When sent as a present by one chief to another at a distance, the seeds are received as a sign of friendship, and the compliment is always reciprocated. In parts of the country where the kola tree is not indigenous, no business can be done with the higher classes without the gift of some of the nuts. Wives also are purchased with kola seeds; and the fetish man who raises the dead completes his charms with the offering of some of the seeds the deceased loved so much when alive. They are used, too, as propitiatory offerings to malignant spirits, and with peculiar customs to decide the question of peace or war between distant tribes. They are highly appreciated, too, as a gift on the departure of a guest for a long journey, in the course of which they are found of the greatest value in supporting strength and allaying hunger. The Portuguese, Dutch, and English residents in Western Africa have adopted the use of the seeds, and now they seem to have become a necessity. They are not eaten at meals, but are carried in the hand, and fragments are chewed at intervals, the pulp being spat out, and the soluble part only swallowed. The seeds have been supposed to possess the qualities of Peruvian bark; but the most prominent physiological effect of their use is insomnia, or want of sleep, and on this account they are used by the natives to prolong their orgies. The Portuguese have made a yellow dye from the seeds. With regard to the name, it would seem that the seeds were originally called "Goro," or "Guro;" but the tribes of Western Africa, from a physical defect, are unable to pronounce the letter "r," for which they substitute "l," and among them the nuts are called "Kola," or "Gola," a name which has been adopted by the Portuguese. Dr. Daniell then gave extracts from the earlier African travellers, which showed that they had heard or become acquainted with the use and properties of the Kola seeds. Lastly, he stated that when on the Gold Coast in 1850 he suffered from a severe diarrhœa, for which the inhabitants were in the habit of employing a decoction of fresh seeds. He tried the remedy, and found that it deprived him of sleep. This led him to suspect the presence of theine in the seeds, and, when in Jamaica some years afterwards, he made some experiments to determine the presence, if possible, of this alkaloid. He did, in fact, obtain some crystals, which later researches have decided to be theine.

The reading of this paper was followed by a verbal account, by Dr. Attfield, of the results of his analysis of the seeds. A report of this, and also of a paper by Mr. Hanbury, "*On the Botanical Origin of Savanilla Rhatany*," we postpone until our next.

As the next Pharmaceutical Meeting will take place on the 1st of March, the day on which the *Pharmaceutical Journal* reaches the members, we may announce at once that at that meeting Dr. Redwood will read a paper, "*On the Preparation of Nitrous Ether and Sweet Spirit of Nitre.*"

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, January 10, 1865.

E. W. Binney, *F.R.S.*, *F.G.S.*, *Vice-President, in the Chair.*

Dr. Roscoe exhibited some very interesting photographs of the fixed lines in the solar spectrum made by Mr. Rutherford, of New York. These photographs exhibit groups of thousands of lines extending from near the line *b* in the green to beyond H in the violet, and serve as a most valuable confirmation of the accuracy of Kirchhoff's maps. Each line in these maps can be easily and distinctly traced in the photograph, whilst many bands drawn as single ones by Kirchhoff are seen in the magnified photograph to consist of bundles of fine lines. These photographs were prepared with three 60° bisulphide of carbon prisms.

Dr. Roscoe also exhibited two fine photographic prints of the moon, enlarged by Mr. Rutherford from negatives taken by him in New York with an 11¼ inch object-glass of 14 feet focal length, which he had ground with special reference to the highly refrangible rays, and which is therefore unfit for ordinary telescopic purposes.

Mr. Baxendell and Mr. Wilkinson, F.R.A.S., expressed their opinion that Mr. Rutherford's prints were decidedly sharper than any photographs of the moon they had seen.

A paper, by Dr. E. Schunck, F.R.S., Vice-President, was read "*On Some Products Derived from Indigo Blue.*" By his experiments on the formation of indigo blue, an account of which was laid before the Society several years ago, the author was led to make some inquiries regarding the processes employed in tropical countries for the production of indigo from plants. All authorities, it appears, agree that the process of fermentation, which is the one usually adopted for the purpose of extracting the colour, requires to be conducted with the greatest care in order to lead to a successful result. Unless certain precautions are adopted the colouring matter may be entirely lost. This phenomenon may be easily accounted for. Though indigo blue, when once formed, is a very stable body, the substance existing in the cells of the plant from which it originates, and which the author terms *Indican*, is decomposed with the greatest facility, indigo blue being only one of its products of decomposition, which may be formed or not, according to the nature of the process employed. There are, however, other facts connected with this subject which cannot so easily be explained. It is well known to those dyers who employ the so-called *woad vat*, in which the reduction of the indigo blue is effected by means of various organic maters, such as woad, madder, and bran, together with lime, that if the process be not carefully managed it may change its character entirely—a change which results in the total destruction or disappearance of the colouring matter. This phenomenon cannot be explained in accordance with what is at present known regarding indigo blue, which is considered by chemists to be a body of such a stable character as not to be decomposed by any except very potent agents, such as chlorine, bromine, or nitric acid. It has not hitherto been supposed possible to effect its decomposition by means of fermentation or putrefaction. Then, again, the author found that when very small quantities of indigo blue are reduced according to Fritzsche's method, which consists in acting on it with alcohol, grape sugar, and caustic soda, the colouring matter does not make its appearance again when the solution is exposed to the atmosphere. The liquid yields no deposit and remains yellow and transparent. This fact is also difficult to account for, since it is usually supposed that by the combined action of reducing agents and alkalies indigo blue merely takes up an atom of hydrogen and then dissolves, and by the action of oxygen is again precipitated unchanged and undiminished in quantity. By the continued action of a large excess of alcohol and grape sugar, together with caustic soda, the author succeeded in causing several grammes of indigo blue to disappear entirely. That the effect was due to the combined action of alcohol and grape sugar, not to that of one or the other only, was proved by subjecting a small quantity of indigo blue to the action of grape sugar and caustic alkali in watery solution, and another portion to the action of alcohol, protoxide of tin, and alkali. Reduction of course took place in both cases; but, though the solutions were boiled for some time, the colouring matter was in each case precipitated again on exposure to the air, apparently undiminished in quantity. Since, by the action of caustic alkalies on grape sugar, acetic and formic acids are formed, it occurred to the author that the effect produced by the sugar in this process might in reality be due to the presence of one or both of these acids rather than to the sugar itself. This supposition was completely verified by experiment. The colouring matter disappeared quite as rapidly when acetate or formiate of soda was employed in the place of grape sugar. The use of the latter was therefore abandoned in the subsequent experiments. In the present communication the author confines himself to an account of the combined action of alcohol, acetate of soda, and caustic soda on indigo blue. The process adopted was quite simple. Pure indigo blue was introduced into a large quantity of ordinary spirits of wine, and, after being well agitated, the mixture was raised to the boiling-point. A quantity of pure acetate of soda, previously deprived of its water of crystallisation, and a little caustic soda were then added, and the boiling was continued for several hours. A reduction of the indigo blue took place in the first instance, as was evident from the deep red colour of the liquid. On agitating with air this red colour disappeared for a moment, the indigo blue being precipitated in powder, but after some time the liquid acquired a dark brown colour and deposited nothing on exposure or agitation. The process was then completed. In order to obtain the products formed, the brown liquid was evaporated, and, when the evaporation was nearly completed, water and an excess of sulphuric acid were added, which threw down a brown insoluble mass, consisting partly of resinous, partly of pulverulent substances. From the liquid, which was of a light brown colour, a crystallised acid was obtained, which after being purified was found to consist of anthranilic acid. From the mass, insoluble in water, the author obtained five distinct substances, which were separated from one another by means of various solvents, such as alcohol, ether, ammonia, and carbonate of ammonia. These substances were all brown and amorphous. Some of them resembled resins, others were powders. In general they were found to possess very few characteristic properties, and as they presented very little that could be of interest to the chemist, if their origin and their mode of formation be excepted, the author refrained from bestowing names on them, and thus adding to the already unwieldy mass of terms with which chemical science has to deal, but preferred to distinguish them by the letters of the alphabet, as A, B, C, D, and E. The body A is easily soluble in cold alcohol and ether, but quite insoluble in alkalies. B is easily soluble in alcohol and ether, as well as in alkalies, both caustic and carbonated. These two have the appearance of resins of a rich brownish-yellow colour. C is very little soluble in alcohol and ether, and insoluble in alkalies. D closely resembles C, but is distinguished by its solubility in alkalies. E is remarkable for being soluble in a boiling solution of acetate of soda. These three are brown powders. That portion of the mass soluble in alcohol and alkalies, but insoluble in ether, was not examined, as it was sure to contain some of the peculiar resinous product of decomposition, which is always formed by the action of caustic alkalies on alcohol, and which is supposed to be identical with the so-called "aldehyde resin." The author's analyses of these five bodies led to the following formulæ:—

A	$C_{62}H_{39}NO_8$
B	$C_{52}H_{35}NO_8$
C	$C_{28}H_{11}NO_4$
D	$C_{56}H_{24}N_2O_{10}$
E	$C_{28}H_{11}NO_6$

The author attaches no importance to these formulæ, except in so far as they furnish a means of explaining the mode in which these bodies are formed. It will be seen that they all contain the elements of indigo blue, alcohol, and acetic acid in various proportions. Taking as an instance the body C, which is the simplest in constitution, it is apparent that it has been formed by the union of 1 atom of indigo blue, 1 atom of alcohol, and 2 atoms of acetic acid, 8 atoms of water being at the same time eliminated, since

$$C_{28}H_{11}NO_4 + 8HO = C_{16}H_3NO_2 + C_4H_6O_2 + 2C_4H_4O_4.$$

In like manner E originates from the combination of 2 atoms of indigo blue, 1 atom of alcohol, and 5 atoms of alcohol, for

$$2(C_{28}H_{11}NO_6) + 14HO = 2(C_{16}H_5NO_2) + C_4H_6O_2 + 5C_4H_4O_4.$$

The formation of B will be easily understood by a glance at the following equation:—

$$C_{52}H_{35}NO_8 + 18HO = C_{16}H_5NO_2 + 6(C_4H_6O_2) + 3(C_4H_4O_4).$$

In the case of A, which is the most complex of all, it is necessary to assume that carbonic acid comes into play, since

$$C_{62}H_{39}NO_8 + 26HO = C_{16}H_5NO_2 + 8(C_4H_6O_2) + 3(C_4H_4O_4) + 2CO_2.$$

It is difficult to say whence this carbonic acid is derived, but the author supposes it may originate in the decomposition of that portion of the indigo blue which yields anthranilic acid. Hence it appears that all these products, except anthranilic acid, are formed by a very simple process, which consists merely in indigo blue taking up alcohol and acetic acid in various proportions and forming compound bodies in which none of the constituents, as such, can be detected. It is, therefore, not a process of decomposition, but a synthetical process, a building up of complex bodies from others of a simpler constitution. This is proved by the fact of water being given up during the process, whereas in all cases in which complex organic substances are decomposed into simpler ones, water is absorbed. Regarding the real constitution of these bodies the author hazards no speculations. It might be supposed that they belonged to the class of conjugated compounds, of which organic chemistry furnishes us with so many examples, and that by decomposition we should be able to obtain from them some of the simpler bodies which are known to have entered into their composition, but the author's experiments, as far as they have gone, do not countenance this view. He was unable to obtain from any one of them either indigo blue, alcohol, or acetic acid. The occasional disappearance of the indigo blue in the woad vat in consequence of mismanagement now admits, the author thinks, of an easy explanation. By the fermentation of the sugar contained in the madder employed, alcohol is formed, which in its turn may yield some acetic acid and alcohol, acetic acid and a base (lime) being present, nothing further is required for the development of the process described by the author.

Professor Roscoe suggested that some of the bodies described by the author might possibly be represented as substitution products, one or more of the atoms of hydrogen of the indigo blue being replaced by one or more organic radicles.

A paper was also read "*On Some Physiological Effects of Carbonic Acid and Ventilation,*" Part I., by Dr. R. Angus Smith, F.R.S., President.

ACADEMY OF SCIENCES.

January 30, 1865.

M. Becquerel communicated some determinations "*Of the Temperature of the Earth from* 1 to 36 *Metres Below the Surface, and of the Air up to* 21·25 *Metres Above the Surface of the Earth.*" The author made his experiments with a thermo-electric pile. He finds that the increase of temperature as we descend into the earth is not uniform: for example, the mean increase at a depth of 5 metres was 0·272°; but after reaching the depth of 16 metres, it was only 0·102° for the next five metres. A difference of 1·956° was found between the temperature at a depth of 1 metre and 36 metres. The author supposes that the irregularity of the increase depends upon the nature of the strata passed through. The experiments made in the air show that the temperature rises with the height, up to 21 metres at least. An interesting fact noticed was, that at 6 a.m. the temperature at four different heights, up to 21 metres, was always sensibly the same at each, varying, of course, from day to day; and the author considers that some relation must exist between the mean annual temperature and that of the air at 6 a.m., at which hour terrestrial and celestial radiation may be supposed to compensate each other. M. Becquerel wishes to carry his experiments to further depths and heights.

MM. Bussy and Buignet communicated some "*Researches on the Reciprocal Action of Cream of Tartar and Sulphate of Lime.*" Wine makers in all countries are in the habit of putting gypsum into their wine either before or after fermentation. The custom is a very old one, and nobody can say exactly why they follow it—the wine-maker asserting that the wine is greatly improved by the addition, and the knowing part of the public declaring that the result is most pernicious. A Greek physician once tried to convince us that the gypsum caused next morning headaches. The authors of this paper have been moved to discover what happens when sulphate of lime is brought into contact with bitartrate of potash in an alcoholic mixture, and they have found that the results are neutral tartrate of potash, tartrate of lime, and sulphuric acid, or rather bisulphate of potash.

M. Janssen contributed "*A Memoir on the Telluric Lines of the Solar Spectrum.*" It contains the results of some observations made last summer on the Faulhorn. It appears from them that the telluric lines diminish, and the solar lines increase, in intensity the higher the observations are made. This, the author remarks, is quite opposed to the results Mr. Glaisher obtained during a balloon ascent, who observed that the solar lines diminished in intensity the higher he went.

We can only mention the titles of two papers which will be found of interest to physiological botanists—"*On Tannin in the Leguminosæ,*" and "*On the Production of Grapes with a Coloured Juice by Artificial Fecundation.*"

M. Moncel contributed some new experiments "*On Electro Magnets with Uncovered Wires.*" This paper places the author's previous communications in a somewhat different light. It seems that M. Carlier's machine was made with very impure copper wire of low conducting power.

M. Marignac presented a note "*On Hyponiobic Compounds.*" From a study of the crystallographic relation of various double fluorides of hyponiobium, the author has come to the conclusion that Rose's hyponiobium is not an allotropic modification of niobium, but an oxide of that metal. The author apologises for enunciating this theory without being able to demonstrate its truth, but supports his views by the discordant results of Rose's analyses of the hyponiobic chloride, which, if the compound is regarded as an oxychloride, according to Marignac's views, become quite concordant.

M. Lambron presented a note "*On the Electricity developed in the Sulphurous Waters of Bagnères de Luchon.*" The waters, the author says, when received in a glass or bath, show an excess of positive electricity on the upper surface, and an excess of negative electricity on the lower surface; and when a person is in a bath he completes a circuit, and has a stream of electricity running through him. Moreover, when a patient gets a *douche* of the water, the part of the body soused is negatively electrified, the other parts of the body being positive. Of course the currents must produce a certain action on the animal economy; and it is to be noticed that the waters when transported from their source do not lose their electrical properties.

M. Richer, in a short note "*On a Sulphur Electrical Machine,*" mentions that a disk of sulphur makes an excellent machine for frictional electricity. He melts it and cools it rapidly three or four times, and then moulds it into a disk which may be two or three centimetres thick and a metre in diameter. In reference to this paper, M. Deville recalled the fact mentioned by M. Dietzenbacher some time ago—namely, that the addition of a little iodine or bromine gave great plasticity to sulphur.

NOTICES OF BOOKS.

Journal für Pracktische Chemie. No. 22. 1864.

In a paper "*On the Double Salts of Oxalate of Calcium and Chloride of Calcium,*" by J. Fritsche, the author mentions that he has formed one having the composition $3\text{Ꞓ}_2\mathrm{Ca}_2\Theta_4 + 2\mathrm{CaCl} + 8\mathrm{Aq}$. It is got by dissolving oxalate of calcium in strong hydrochloric acid, which solution on evaporation yields microscopic six-sided prisms of the salt. Two papers by the same author follow, but these have already been noticed in connexion with other journals. A series of communications on chemical technology by Professor Bolley succeed; the first is "*On the Genesis of Silk;*" from the belly of a worm killed at the proper stage, the silk juice may be drawn out and spun into threads coarser and stronger than the animal spins itself. The analysis and properties of the substance showed it to be *fibroin.* When spun by the animal this fibroin becomes partly oxidised and hydrated, and the yellow gum is formed on the surface.

The next article is "*On the Red Colouring Matter of Sapan Wood,*" which the author shows to be identical with the colouring matter of Brazil wood.

Two papers, one by Professor Bolley and another by W. Stein, establish the identity of chrysopikrin, the yellow dye from Parmelia parietina, and vulpinic acid the colouring matter from Cetraria vulpina.

Professor Bolley also gives an account of the "*Tinctorial Properties of Soga or Cuoa Bark,*" a decoction of which gives a solid brown colour to wool and cotton with tin or alum mordont, and greenish-black with iron mordant.

Dr. Piccard describes a new colour-begetting matter, *Chrysinic Acid*, $C_{22}H_8O_6$, which he has extracted from the leaf buds of various species of poplar, Populus monolifera, nigra, and pyramidalis. A concentrated tincture is precipitated with basic acetate of lead, and the precipitate washed, decomposed, &c., as usual. After several purifications, the acid is obtained in colourless crystals. Several salts of the acid are described. Solutions of the acid quickly turn yellow at the ordinary temperature, and orange coloured if heated. The author gives some reasons for supposing that chrysinic acid stands in some relation to chlorophyll.

Chemisches Central-blatt. Nos. 1 and 2, 1865.

Although we are in general enabled to keep in advance of this very useful journal with much of its information, we are nevertheless often indebted to it for extracts from periodicals which do not reach us. Most of the papers in these two numbers have, then, already been noticed in the Chemical News; but several short extracts will find a place in our columns under their proper heads. Communications by Batka, "*On the Wax of the Sumachs;*" by Dr. Dullo, "*On the Adulteration of Wax;*" and "*On Silk and Wool,*" by Grothe, and others of interest, we shall translate for an early number.

Zeitschrift für Chemie und Pharmacie, &c. December, 1864.

The only paper in this number we need notice is "*A Contribution to the Knowledge of Albuminous Matters,*" by F. Hoppe Seyler. It is, however, little more than a synopsis of the albuminous matters of the body which have been distinctly separated and recognised. Among them the author places the amyloid substance found in the liver and other organs.

In future this journal will be edited by Hubner, with the co-operation of Beilstein and Fittig, whose announcement leads us to expect considerable changes in the contents. Under Dr. Erlenmeyer these have consisted principally of extended essays on theoretical subjects, and long accounts of original researches. The new editors promise short articles on all novelties.

NOTICES OF PATENTS.

1334. *Preparing Cements Applicable in the Making of Mouldings on Wood.* P. G. Etesse, Paris. Dated May 30, 1864. (Not proceeded with.)

For internal work the inventor uses a composition made of "double size" melted by a gentle heat and mixed with half its weight of plaster of Paris and a small quantity of soddened paper or paper pulp. These ingredients are modified by the introduction of Roman cement when required for external application.

The toy manufacturers make use of a somewhat similar moulding material composed of plaster of Paris in combination with the short cotton fibres which the paper-makers find unserviceable, and sell under the name of "rag dust."

1349. *Treatment or Distillation of Bituminous Substances.* J. Young, Bucklersbury, London. Dated May 31, 1864.

In the distillation of bituminous substances, with the view of obtaining oils and volatile products therefrom, the inventor employs as the source of heat a current of hot permanent gas, which, being devoid of oxygen or other active elements, cannot exert any destructive action upon the hydrocarbons or other volatilised products given off during the treatment.

Nitrogen would, under ordinary circumstances, be the permanent gas selected; and the inventor prefers to arrange a number of retorts in series. For the removal of the oxygen from air a passage over red-hot charcoal or iron, or a mixture of these, would be effectual; and the process seems capable of modification by substituting hydrogen for nitrogen, when the gaseous products would probably be worth collecting.

1360. *Singeing Yarns and Fabrics.* H. Ambler, Halifax. Dated June 1, 1864.

The inventor states that when employing a gas flame for the purpose of singeing off the loose fibres of yarns and fabrics, it is better to cause a blast of air to blow on to such flame than to mix the gas and air before ignition, and that a more intense heat is the result.

It is very probable that the flickering nature of the gauze burner renders it unfit for this special application, although its heating power may not be actually inferior to the gas arrangement above described.

1362. *Manufacture of Chromic Acid and Chromates.* F. O. Ward, Hertford Street, Mayfair, London. Dated June 1, 1864.

In the fusion of chrome ore for the purpose of producing chromic acid or an alkaline chromate, the inventor adds a small proportion of fluor spar, or other compound of fluorine, whereby the reduction of this very refractory mineral is greatly facilitated.

1366. *The Manufacture of Ferro Manganese and Cupro Manganese, and the Combinations or Alloys thereof, with other Metals.* O. E. Prieger, Manchester. Dated June 2, 1864.

The inventor obtains certain useful alloys of manganese, with iron and copper respectively, by reducing the crude oxides of manganese with carbon, in contact with copper or iron. Several modes of operating are described in the specification.

CORRESPONDENCE.

Continental Science.

Paris, February 3.

Vital statistics possess an interest for every one, and a note from M. Jean Dollfus, of Mulhouse, may perhaps be read with profit by many subscribers to the Chemical News in Manchester. The firm Dollfus and Co. employ 1150 women in their factories, and the firm pays the wages of every woman lying-in for six weeks, so that she may take the necessary care of her infant. They were stimulated to this by the sacrifice of infant life, which appeared to arise either from the necessities or neglect of the parent. The mortality of infants has always been higher in Mulhouse than other parts of France, but the philanthropic efforts of one firm has reduced the mortality, so far as their own *employés* are concerned, 13 per cent.

There is another matter which interests many people—the consequences of marriages between relations. All know the ideas that are commonly entertained on this subject, both in this country and in England, but M. Voisin, of Batz, communicated to the last meeting of the Academy the results of forty-six marriages contracted by cousins of different degrees, from which it appears that all these marriages have been fecund, that the offspring live and grow well developed and in good health—in fact, none of the evil consequences which have been ascribed to intermarriages have been found to spring from these unions.

I may mention here that the manufacturers of Mulhouse have petitioned for a Factory Act to prevent women and children under eighteen from working between ten at night and five in the morning.

Lenoir's gas engine is being employed in Paris for raising building materials, for which one or two horse-power is found very efficient and economical.

Your photographic readers may be glad to know that a grand international photographic exhibition will open at Berlin on the 15th of May next. All objects for exhibition, which may include pictures, chemicals, cameras, indeed, everything concerned in the art, must be delivered at Berlin on or before the 1st of May.

At the last meeting of the Academy the newly-elected member, M. Léon Foucault, took his place. M. Foucault is a favourite at the Tuileries, and elected on the 23rd of January, the decree confirming his election was signed on the 25th. Such promptitude, it is said, was never shown before. More than this, when the newly elected academician accompanied his brother members of the Bureau des Longitudes to the palace to present the Annuaire the Emperor took M. Foucault by the arm, and held a short conversation with him.

MISCELLANEOUS.

Chemical Society.—The next meeting of this Society will be held on Thursday, February 16, at 8 o'clock, when the following papers will be read:—"New Reaction for Preparing Anhydrides and Ethers," by Mr. J. Broughton. "Chemistry of Calabar Bean," by Dr. Fraser. "Action of Silicate and Carbonate of Soda on Cotton Fibre," by Mr. Crace Calvert. "New Electric Lamp Regulator, &c.," by Mr. S. Highley. "Oxidation of India-rubber," by Mr. J. Spiller.

Royal Institution.—The following are the arrangements for the ensuing week:—Tuesday and Thursday, February 14 and 16, at 3 o'clock, Professor Tyndall, F.R.S., "On Electricity." Friday, February 17, at 8 o'clock, W. Huggins, Esq., "On the Physical and Chemical Constitution of the Fixed Stars and Nebulæ." Saturday, February 18, at 3 o'clock, Professor Marshall, F.R.S., "On the Nervous System."

Suggestions to Patentees.—We copy the following remarks from the judgment of the Lord Chancellor in Simpson *v.* Holliday for the information of those of our readers who are or may become patentees. Coming from such an authority, the suggestions merit the earnest attention of inventors:—"Cases of this nature frequently give rise to complaints of the state of the law. It is, therefore, right to point out how entirely the plaintiff's failure has arisen from not availing himself of the salutary provisions of the existing statutes. The provisional specification proves that a valuable discovery had been partially made, but not matured; and that the true conditions on which it might become an invention of practical utility had not been ascertained. Six months are allowed by the law for maturing the invention and accurately ascertaining and stating it; but in this case there does not appear to have been any attempt by the patentee to improve his knowledge; for the complete specification is a mere repetition of the provisional. Lastly, the inefficiency of the cold process, and the dangerous language of the specification, must have been known long prior to this suit, and yet there was no attempt to remove the objection, as might easily have been done by a disclaimer under the statutes."

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. *Private* letters for the Editor must be so marked.

R. H.—We cannot say where you will find an account of Hearder's and Ladd's latest improvements in the coil.

T. W.—Received with thanks. The errors shall be corrected when inquired into.

J. Y. S.—1. We think it probable that you might succeed; but the first qualification required in a salaried *employé* is practical experience. We cannot offer advice, but may remark that it is possible to pursue commerce and science together.

Received.—P. Le Neve Foster.

Errata.—No. 270, p. 50, col. 2, line 3 from bottom, *for* "commercial," *read* "concentrated." Page 59, col. 1, line 29 from top, *for* "hours," *read* "horses."

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

An Introduction to Chemical Philosophy, according to the Modern Theories, by Adolphe Wurtz, *F.R.S.*

Part I.

Equivalents, Atomic Weights and Molecular Weights.

Section I.—*Historical Development of the Ideas, Equivalent, Atom, Molecule.*

(*Continued from page* 49.)

Multiple Proportions.—Atoms.—The idea of atoms arises from a fundamental discovery which was made about 1804 by Dalton, and which depends upon facts entirely distinct from those observed by Wenzel and Richter. Having studied the composition both of olefiant and of marsh gas, Dalton perceived that for the same quantity of carbon, the latter contained exactly double the quantity of hydrogen which was contained in the former. He made analogous observations concerning the composition of carbonic oxide and carbonic acid, and of the compounds of oxygen and nitrogen. In this way he discovered the *law of multiple proportions.*

The following is the explanation of this law:—When two bodies, either simple or compound, form several combinations with each other, if the weight of one of them be taken as constant, the weight of the other varies in a very simple ratio. Thus, nitrogen forms five combinations with oxygen. If we take quantities of these compounds containing the same weight of nitrogen, the weight of the oxygen in them will be in proportion to the numbers 1, 2, 3, 4, 5.

For example:—

		Of nitrogen.	Of oxygen.
Protoxide of nitrogen	contains for	175 parts	100 parts
Binoxide of nitrogen	,,	175 ,,	200 ,,
Nitrous acid	,,	175 ,,	300 ,,
Hyponitric acid	,,	175 ,,	400 ,,
Nitric acid	,,	175 ,,	500 ,,

The acute intellect of Dalton did not stop at facts, but sought to explain them by devising a theory. Reviving an idea of Leucippus and a statement of Epicurus, he supposed that bodies were formed of small indivisible particles which he called atoms. To this old and vague notion he gave a distinct meaning by admitting, on the one hand, that for every kind of matter the atoms possess a uniform weight, and, on the other, that combination between different kinds of matter is the result of the juxtaposition of their atoms. This fundamental hypothesis being admitted, the fact of definite proportions and of multiple proportions finds a simple and satisfactory explanation. The definite proportions according to which bodies combine represent the unvarying relations between the weights of the atoms which are in juxtaposition; and if a body can combine with another in several proportions, such multiple combinations can only be effected by the juxtaposition of 1, of 2, of 3, of 4, &c., atoms of one body and one or several atoms of another body. The evident result is, that if the weight of this latter body is constant, the weights of the other in the different combinations ought to be multiples of one another.

As immediate consequences of these propositions, Dalton inferred that the atomic weight of a compound body was formed by adding together the atomic weights of its elements, and that the definite proportions according to which compound bodies, such as acids and bases, combine, represent merely the uniform relation between their atomic weights. Thus the laws of Wenzel and Richter are seen to be only particular cases of a general law which governs the composition of all bodies. The atomic hypothesis explained them at once.

But these atomic weights have no absolute value; they only represent the proportions according to which bodies combine. An unit must be chosen as a term of comparison. Dalton referred all the atomic weights to that of hydrogen, which he called 1. In a work entitled *A New System of Chemical Philosophy*, published in 1808, he gave the following table:—

	Dalton's atomic weights.	True numbers.
Hydrogen	1	1
Nitrogen	5	7
Carbon	5	6
Oxygen	7	8
Sulphur	13	16
Magnesia	20	20
Lime	23	28
Soda	28	31
Potash	42	47·1
Strontia	46	51·8
Baryta	68	79·5
Iron	38	28
Zinc	56	32·6
Copper	56	31·7
Lead	95	103·5
Silver	100	108
Platinum	100	98·7
Mercury	167	100

Thus, for a certain number of bodies Dalton's numbers come very near to theory. This accordance is still closer in a table published by Wollaston in 1814,[*] in which the atomic weights, or rather the equivalents (to use Wollaston's term), are referred to that of oxygen, which is taken as 10.

(To be continued.)

Purification of Commercial Arseniferous Hydrochloric Acid,[†] *by M.* Aug. Houzeau.

In the preparation of weak acid it is only necessary to boil the commercial arseniferous acid in a flat-bottomed dish until the acid is reduced to two-thirds of its original volume. By allowing the hydrochloric gas to escape without collecting it, all the arsenic is taken with it in the form of chloride ($AsCl_3$), and the liquid remaining in the dish is no longer arseniferous; eight litres of commercial acid, treated in this way, furnish in less than three hours two litres of weak acid free from arsenic.

Preparation of Fuming Acid.—The apparatus required for this operation consists of a flat-bottomed vessel of six litres capacity, into which first pour three litres of arseniferous acid, and add 0·3 gr. of powdered chlorate of potash (0·1 gr. per litre). Then adapt to the mouth of the flask a cork pierced with two holes, into one of which fit a straight and strong safety tube; and into the other a larger tube, of the diameter used in organic analyses, 0·5 m. long, and serving, so to speak, as a vertical elongation. This lengthened tube should be very little tapered at its lower part; fill it with filings of red copper well beaten down (about 100 grms.), to within 0·07m. of its upper orifice, and then fill it almost entirely with asbestos or broken glass. Pass the greater part of this tube through the neck of the flask, so that as much as possible of the surface may be heated by the

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[*] *Annales de Chimie*, xc., 138.

[†] *Comptes Rendus*, lix., 1025. 64.

hydrochloric vapour. Then furnish the upper part of the elongated tube with a tube to carry the gas into a receiver. In traversing the column of copper the acid gas is deprived of its chlorine, and arrives in a pure state in the water destined to dissolve it. The mode of operation is very easily comprehended. By boiling the acid the transformation of the chloride of arsenic into fixed arsenic acid is completed by the decomposition of chlorate of potash; the excess of chlorine is taken with the moist hydrochloric gas into the copper, which most readily absorbs it, in preference to the acid, for which its affinity is much less. The chloride of copper returns to the flask in the form of a solution, while the gaseous hydrochloric acid condenses in the distilled water. But as it is important that there should always be, in the boiling acid, a slight excess of chlorine, to prevent the reduction of the arsenic acid, a constant current of hydrochloric acid, to each litre of which one gramme of chlorate of potash has been added, should arrive through the safety tube (which should not dip more than from three to five centimetres into the liquid) so as always to maintain a small excess of chlorine, and at the same time to replenish the flask with hydrochloric acid to be purified. Generally the proportion of liquid acid thus added should be greater than is required for distillation, otherwise there might be an insufficiency of chlorine. When the experiment has been successfully performed the hydrochloric acid contains neither arsenic nor chlorine.

By in some degree modifying this apparatus pure hydrochloric acid may be constantly obtained without any sensible loss of acid, and the process may then be applied commercially.

The Electro-chemical Properties of Hydrogen, by M. CROVA.

HYDROGEN, rightly called by M. Dumas a gaseous metal, is distinguished from all the other bodies in the range of chemistry by a number of very remarkable physical and chemical properties.

A metallic plate covered with hydrogen proceeding from the decomposition of an electrolyte possesses an electro-motive force varying with the intensity of the current, that is to say with the amount of gas disengaged in a given time at the surface of this plate, and which may be calculated exactly by means of a logarithmic formula.

When mercury containing a small but variable quantity of oxidisable metal is employed as the negative metal of a pile, the electro-motive force diminishes rapidly with the quantity of oxidisable metal contained in the amalgam, provided the quantity is very small.

The hydrogen disengaged at the surface of a metallic plate is always more or less in a condition similar to that of an oxidisable metal contained in minimum proportion in an amalgam.

Mercury, which has served as a negative electrode in the decomposition of water, has the property of disengaging when heated bubbles of hydrogen, and substituted for the zinc of a pile it exhibits all the behaviour of an oxidisable metal in which the proportion of this metal would be extremely small. Very pure mercury through which a current of ordinary oxygen has passed does not sensibly differ from simple mercury; but this same mercury after having been submitted to the action of a current of hydrogen proceeding from the decomposition of water by the pile at a low temperature, and containing consequently traces of Ozann's allotropic hydrogen, presented, though to a very slight degree properties analogous to those of mercury, which has served to disengage hydrogen electrolytically.

The author has repeated these experiments by cooling the mercury to about 20°, and has succeeded in slightly increasing the quantity of hydrogen absorbed by the mercury, but the amount is nevertheless very small.

An amalgam of zinc plunged in diluted sulphuric acid disengages hydrogen. At the ordinary temperature this disengagement is very slow, on account of the very slight difference existing between the electro-motive force of the zinc and that of the hydrogen. When the zinc has been recently amalgamated the surface is covered with a slight layer of liquid amalgam, which on account of the perfect polish of its surface renders the disengagement of hydrogen very difficult. But after a certain time the mercury and the zinc combine more intimately and form a crystalline amalgam. The amalgamated zinc then loses its brilliancy, and plunged in diluted sulphuric acid disengages hydrogen sensibly; the surface of the metal, roughened by the crystallisation of the amalgam, favours the disengagement of hydrogen.

We know that a plate polarised by hydrogen still manifests a feeble polarisation when washed and rubbed with emery paper. The current given by an unpolarised platinum plate, associated with another plate polarised by hydrogen, quickly becomes weaker, and is after a time extinguished. If the circuit is then broken, and after a certain time the communication is re-established, the current reappears, though more feebly, and this phenomenon may be several times repeated.

The author disengaged hydrogen by means of the pile on one face of a very thin platinum plate, the posterior face of which rested in a bath of diluted sulphuric acid, and was placed opposite a second platinum plate perfectly unpolarised. Though no hydrogen is disengaged on the first plate its posterior face put in communication with the second plate by the wire of a galvanometer detects no current. When hydrogen is disengaged on the first plate its posterior face, put from time to time in communication with the second plate, still shows no current, but after a time varying according to the thickness of the plate, the posterior face manifests increasing signs of polarisation by hydrogen. If by reversing the current of the pile oxygen is disengaged on the first plate, all trace of polarisation disappears from the posterior face, and these alternations may be repeated any number of times. This experiment, which the author has varied in many ways, seems to him to prove that platinum is electrolytically permeable to hydrogen. The metallic nature of hydrogen seems to him to receive still further confirmation from these facts, and he believes that the generalisation of this idea may prove of value in explaining various electro-chemical phenomena.—*Les Mondes.*

On the Supposed Nature of Air prior to the Discovery of Oxygen, by GEORGE F. RODWELL, *F.C.S.*

(Continued from page 39.)

In Obs. 16 "Of charcoal or burnt vegetables," Hooke propounds his celebrated theory of combustion, a most philosophical and ingenious theory, and far in advance of the chemical knowledge of the day.

From very ancient times, fire was believed to be an element more divine than air, water, and earth, and to occupy a place above them; we find this theory in the most ancient Vedas, in the Zend Avesta, and in the writings of Sanchoniatho; indeed, we know that fire was the divinity of the Zoroastrians, and first invoked among the deities of the ancient Hindus, was Agni, the god of light and fire. Fire was universally believed to be an element till the time of Bacon, and almost universally for many years afterwards: Bacon,* in his investigation of the nature of heat, denies that it is elemental, and states his belief that it is "merely compounded of the conjunction of heat and light in any body;" heat, he elsewhere affirms, is a violent motion of the smallest particles of bodies, and heat can produce light, hence he completely destroyed the elemental nature of fire. Hooke went much further than this, for his theory affirmed:—

1. That the air is the "universal dissolvent of all sulphureous bodies."

2. That the dissolution does not commence until the body to be dissolved has been heated to a certain temperature.

3. That the process of dissolution generates that which we call *fire*.

4. That the process of dissolution is performed with such intense violence that it agitates the smallest particles of the combustible matter, with sufficient rapidity to generate "the action or pulse of light."

5. That the solution of sulphureous bodies is made by "a substance inherent and mixed with the air, which is like, if not the very same, with that which is fixed in saltpeter."

6. That in the process of dissolution a part of the combustible body is turned into air, and caused to move with it.

7. That in the process of dissolution a part of the combustible body is not turned into air, but is carried up by the motion of the hot air, and when the heat ceases descends again, and this part is a certain kind of salt found in soot.

8. That in the process of dissolution certain bodies capable of being dissolved are carried upwards, and do not suffer dissolution, because the motion of the surrounding air does not allow them to remain sufficiently long in a heat competent to cause them to be acted upon by the air, and this is the combustible part of soot.

9. That there are parts of the combustible body which cannot be dissolved by the air, and are not sufficiently light to be carried upwards by the motion of the hot air, and this constitutes the ash of burnt bodies.

10. That "the dissolving parts of the air are but few," they soon become satiated, and the combustible body then ceases to be acted upon, until it is supplied with a fresh quantity of air; but in saltpetre the dissolving particles abound in great quantity, hence this body is able when melted to rapidly dissolve a large quantity of a combustible body.

11. That as with liquid solvents if we repeatedly add fresh quantities of a weak solvent, the body to be dissolved disappears as quickly as if a strong solvent be added all at once, so if we supply fresh quantities of air repeatedly, as by bellows, to a body undergoing combustion, it suffers solution as quickly as when it is placed in melted nitre.

12. That there is no such thing as an "element of fire," for the "shining transient body which we call flame is nothing else but a mixture of air, and the combustible volatile parts of any body, which parts the encompassing air does dissolve or work upon."

This theory had been worked out by Hooke several years earlier, and was well supported by experimental facts; it is much to be regretted that he does not give any of the experiments, neither has he in any future publication enlarged or developed the theory, although he states that he has here "only time to hint an hypothesis, which, if God permit me life and opportunity, I may elsewhere prosecute, improve, and publish." Assuredly if he had adduced experiments in support of his assertions, the theory of four elements would now have been annihilated; but this, earliest amongst the physical conceptions of the human intellect, was not yet destined to receive its death-blow; that which had dwelt so long in the human mind, had taken such deep root therein, had endured uninjured through the greatest changes of intellectual development, the greatest changes in the tone and mode of thought, had seen the downfall of old systems of philosophy, the rise of new ones, could not so easily be displaced from the minds of men. Many years must pass; experiments must be accumulated; chemistry must free itself from empiricism and become a science; the Phlogistic theory must arise, and be vanquished by a Lavoisier, before that change can take place.

In the 58th observation of the "Micrographia" Hooke treats "of a new property of the air." It is constantly observed, he writes, that the sun and moon, when near the horizon, have their images distorted, and assume a red colour; moreover, trees and other objects are sometimes observed to possess an unsteady appearance at sunset; these effects he attributes to the "inflection or multiplicate refraction of those rays of light within the body of the atmosphere." That the refractive power diminishes with its rarefaction, Hooke proved by viewing an object through a hollow glass sphere, containing much rarefied air, and then admitting air; the object was viewed through an aperture placed in front of the sphere, of such a size that every part of the object was just included in the field of view; on now admitting air to the interior of the sphere, a part only of the object was visible.

We know that the air is less dense the further it is from the surface of the earth, from the fact that the mercury column sinks in a barometer as we ascend a mountain; and, he continues, the law regulating the descent of the mercury may be illustrated by "a means which somewhile since I thought of, and used, for the finding by what degrees the air passes from such a state of density to such a degree of rarity." He next details a number of experiments—made with precisely the same apparatus as that employed by Boyle—which prove conclusively that the volume of air varies inversely as the pressure to which the air is submitted.

It is remarkable that Hooke does not mention Boyle's name in connection with the law, although in the "Defence against Linus," published more than two years previously, Boyle (as we have seen in a former paper) gives a number of experiments clearly proving the law; moreover, he had described his experiments at several meetings of the Royal Society in the presence of Hooke. We cannot imagine that Hooke wished to give Boyle less than his due, for he constantly mentions suggestions which he received from him, and always speaks of him in the highest terms. In the preface to the "Micrographia" he speaks of "the most illustrious Mr. Boyle, whom it becomes me to mention with all honour, not only as my particular patron, but as the patron of philosophy itself;" again, he speaks of "the incomparable Mr. Boyle." It is also remarkable that Boyle does not mention Hooke's name in connection with the law, for the former is always most ready to acknowledge the discoveries and inventions of others. It is impossible to say who first verified the law; at all events, Boyle

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* "Nov. Org.," Book 2, Aph. 20

was the first to suggest that the experiments should be made, and to describe a method for making them. Hooke speaks of his own experiments as *confirming* the law, not as giving rise to it; indeed, both he and Boyle attribute the idea that "the pressures and expansions are in reciprocal proportions" to a Mr. Richard Townley. We must remember that at the time of the discovery of the law the air was the only gaseous body known, and a law which had been proved to apply to one body would obviously be considered of a less importance than one which applied to a whole class of bodies. It is to this that we must attribute the fact that no trouble was taken to ascertain the true history of the law by those writers who lived at the time of its discovery.

The history of the law, as far as I have been able to trace it, seems to be the following:—

1660.—Boyle, in his "Physico-Mechanical Experiments," suggests a method for determining the relation of the density of air to the height of the column of mercury which it supports.

Townley, after reading Boyle's suggestion, makes some experiments on the subject, which induce him to propound the theory that "the pressures and expansions are in reciprocal proportions."

Hooke, not having heard of Townley's theory, makes some experiments, but without finding that "the pressures and expansions are in reciprocal proportions."

Mr. Croune and Lord Brouncker make some experiments on the subject.

1661 (August 2).—Hooke, having heard of Townley's theory, makes some further experiments by a different method, which confirm it.

September 11.—Croune gives an account of his experiments on the subject before the Royal Society.

Boyle, at the same meeting of the Society, describes some experiments previously made, which confirm the theory.

1662.—Boyle, in his "Defence against Linus," publishes a detail account of the experiments described before the Royal Society in the previous year, and affirms that "an accurate experiment of this nature . . . has not yet been made, (that I know,) by any man."

1665.—Hooke publishes in detail the experiments made on August 2, 1661.

1676.—Mariotte, in his "Essai sur la Nature de l'Air," publishes some experiments made by himself and a M. Hubin, which confirm the law.

I must still adhere to the opinion expressed in a former paper, that the law which affirms that the volume of a gas varies inversely as the pressure to which the gas is submitted is rightly "the law of Boyle."

Hooke, not only by his writings, but by inventing and improving many philosophical instruments, eminently benefited experimental science. Now that the old philosophy was to be expelled from the minds of men, now that Nature was no longer to be interrogated by the unaided senses, it was necessary that there should be instruments to assist the inquirer. Hooke was the very man that was wanted at the time; a good mathematician, possessing admirable inventive faculty, and a patient experimenter. He was a greater mechanical genius than Boyle, but I will not say a more ardent experimenter. Both were worthy to put in practice the tenets of the new philosophy; both were true types of the Baconian philosopher: their names will never disappear from the annals of science, will never cease to be reverenced by all true students of Nature.

TECHNICAL CHEMISTRY.

On the Revivification of Animal Charcoal, by Henry Medlock, *Ph.D., F.C.S., M.P.S.*

The principal source of expense in a sugar refinery is that of animal charcoal; and it is a great desideratum to the refiner, commencing with the use of new animal black, to adopt a means of keeping his coal in good condition, and retaining, unimpaired, its decolorising powers after each successive use. I will treat the subject very briefly under the following heads:—

1st. The composition of bone and animal charcoal.

2nd. Its decolorising property, and the causes of its becoming inactive.

3rd. The means of restoring its primitive powers of absorption and decolorisation.

I. The Composition of Bone and Animal Charcoal.—Bone, as is well known to anatomists, is a solid structure composed principally of phosphate of lime and osseine, a modified form of gelatine. The phosphate of lime, or solid portion of the bone, is composed of an infinite number of minute, almost microscopic cells, which are filled up by osseine, and bound thereby, as with a cement, into a solid mass.

The composition of bone, after the removal of adhering fat by boiling, is as follows:—

Phosphate of lime	63·1 per cent.
Carbonate of lime	1·4 ,,
Phosphate of magnesia . . .	2·1 ,,
Other salts	2·4 ,,
Osseine	31·0 ,,
	100·0

When submitted to heat in a closed vessel, to which air cannot gain access, the osseine is decomposed, evolving oily and ammoniacal products, which are, by suitable arrangements, collected and applied to many useful and economical purposes. In the retort remains the cellular structure of the bone in a most porous condition, each cell and pore being coated with a thin film of finely divided carbon, resulting from the decomposition of the organic osseine.

The purely chemical reasons why the porous animal charcoal should possess such extraordinary decolorising and general absorptive properties, is a question I need not now enter into, but I shall do so fully in a forthcoming pamphlet.

II. The Decolorising Properties of Animal Charcoal, and the Causes of its Becoming Inactive.—It is well known to the refiner that his charcoal too soon loses the power of decolorising his syrups, and the question arises, what is this owing to? It is *à priori* assumed that it is owing to the grains of coal becoming coated on the surface with the slimy albuminous and mucilaginous matters contained in the raw sugar, which destroy to a great extent its porosity. This is doubtlessly one cause, but the principal, and by far the most serious cause is the presence of lime in the raw sugar; and which, in a short time effectually chokes up the pores, and, in the process of reburning, cannot be removed, although the mucilaginous materials are destroyed.

III. The Means of Restoring its Primary Powers of Absorption and Decolorisation.—When the charcoal ceases to decolorise, it is usually washed with hot water to remove the syrup remaining therein, and then reburned in closed furnaces of various construction, the object of reburning being to carbonise the colouring matters extracted from the syrups. This restores to some extent the decolorising powers of the charcoal; but at each successive re-burning the coal continues to lose its properties, and at last ceases altogether to act as a decoloriser, unless it be mixed, after each re-burning, with a certain portion of new charcoal.

Another process, and one frequently adopted, is to destroy the organic matters by keeping the charcoal in water, and allowing it to ferment for several days, draining off the water, and adding fresh water containing about ¼ to ½ per cent. of hydrochloric acid. The little acetic acid formed and the hydrochloric acid added, dissolve a small quantity of lime, and so far act beneficially. But the good effect is more than neutralised by the fact of the acids attacking the structure of the bone itself—namely, the phosphate of lime, thus rendering the coal friable, and consequently making much dust and waste.

Having referred to the two methods in common use of revivifying the decolorising powers of charcoal, and alluded to their inutility and defects, I will describe a new method, as simple as it is ingenious, of rendering old and comparatively useless charcoal as good, and, indeed, better than new. Corenwinder, an eminent German chemist, has, by numerous experiments, established this axiom—namely, "That the decolorising power of charcoal used in sugar refining is correlative to its power of absorbing lime." In other words, the more the pores of the coal become choked up with lime, the less is its power of decolorising. Now, to remove the obnoxious lime without attacking the structure of the bone itself, is a question which has occupied for many years the ingenious mind of my friend, Edward Beanes, C.E., F.C.S.

Mr. Beanes, who, by his chemical researches on the sugar plantations of Cuba, has enabled the planters not only to produce much finer qualities of sugar, but considerably to augment their produce, has recently patented a process of restoring to charcoal its primitive properties of decolorising syrups. Mr. Beanes found that charcoal, perfectly dry, and hot, absorbs dry hydrochloric gas with the greatest avidity and in enormous quantity. The gas combines with the lime and converts it into soluble chloride of calcium. After the charcoal has been treated with gas, a portion of untreated charcoal is mixed up with it; the uncombined gas remaining in the pores of the former is taken up by the latter, and the whole becomes neutral; the chloride of calcium is then washed out—requiring only a few hours—and the charcoal is afterwards reburned in the usual way. It is then found that the decolorising power of the charcoal is augmented at least 100 per cent.

The advantages of Mr. Beanes' process are as follows:

1st. It removes the whole of the lime and carbonate of lime from the pores without attacking the phosphate.

2nd. It augments the decolorising powers of the coal upwards of 100 per cent.

3rd. It requires no expensive apparatus, and the process is almost costless, two saleable products being obtained nearly equal in value to the materials employed.

I have thus ventured to introduce Mr. Beanes' process to the notice of English refiners, not simply from feelings of personal friendship, but from the firm conviction that by its general adoption he will confer as great a benefit on his own countrymen as he has already conferred upon the sugar manufacturers of Cuba.

Chemical Laboratory, 20, Great Marlborough Street, London, W.

PHARMACY, TOXICOLOGY, &c.

Manufacture of Perchloric Acid, by CHARLES BULLOCK.[*]

HAVING occasion to prepare perchloric acid in some quantity, the process of M. Deville for obtaining fluosilicic acid was tried as a preliminary step.

The process of M. Deville consists in passing steam through a mixture of fluorspar and silica heated to redness. The water is decomposed with the production of hydrofluoric acid, which takes up silica, and fluosilicic acid distils over.

In the first experiment an iron retort was used, and in place of passing steam through the mixed ingredients, water was allowed to drop slowly on the hot materials through a safety tube. A small amount of weak acid was obtained, after which water distilled over. In the second experiment, the tube for introducing water was carried to the bottom of an iron retort. After a small amount of very weak acid had distilled over, the distillation ceased. An examination of the retort showed that the iron tube passing through the materials in the retort, as also the retort, had fused. The iron had evidently melted below its usual fusing point, owing to the fluorspar acting as a flux.

Another experiment was made with an earthen retort of half a gallon capacity. A porcelain tube was passed through the tubulure of the retort to within an inch of the bottom. Fluorspar and silica, broken into fragments of the size of large peas, were introduced into the retort, which was placed in a wind furnace, and a suitable condensing apparatus connected. When the retort had reached a full red heat, steam was introduced from a steam boiler, by means of suitable connexion. For a short time the process promised well, then ceased.

An examination of the contents of the cold retort showed that the hot silica had been disintegrated by the steam sufficiently to pack the mass too tight for the vapour to penetrate it.

With this experience, I resorted to the process I had before employed for perchloric acid, which, although it claims no novelty, may interest some readers of the journal from its details.

The first step, to obtain perchlorate of potash, is as follows:—

Heat in a porcelain crucible of eight ounces capacity, over a gas furnace, eight ounces of chlorate of potash, until the salt is in complete fusion, taking care that but little or no oxygen is evolved. Then cover the crucible and continue the same amount of heat till the fused salt thickens and crusts entirely over on top. A portion of the salt removed from the crucible should now impart but a light yellow colour to pure undiluted muriatic acid. The crucible is now removed, and allowed to cool. When cold, the fused mass detaches itself completely from the crucible by turning it upside down.

Dissolve the mass in two and a-half pints of boiling water. The perchlorate of potash crystallises out on cooling, and should be washed with water to separate the mother water.

The loss of weight by heating the chlorate of potash was about two ounces in each pound. Amount of perchlorate of potash obtained from a pound of chlorate, about eight ounces. Four hours' heating was required for eight ounces of chlorate of potash, the gas flowing through a six-foot burner to about three-fourths of its capacity.

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[*] *American Journal of Pharmacy.*

Perchlorate of potash is the most insoluble of all the salts of perchloric acid, requiring sixty-five times its weight of water, at 60° F., for solution.

To obtain perchloric acid from perchlorate of potash, the salt is distilled (below the boiling heat of the ingredients) with twice its weight of sulphuric acid mixed with one-tenth part of water, as long as any distillate is obtained. The distillate, containing perchloric and sulphuric acids, together with some free chlorine, and a little hydrochloric acid, is treated with carbonate of lead rubbed into a paste with water, till baryta water no longer disturbs the clear solution. Should an excess of carbonate of lead have been used, the perchlorate of lead is to be carefully decomposed by sulphuric acid. The weak acid is now filtered from the sulphate and chloride of lead, and a few drops of hydrosulphuric acid added, to decompose the slightly soluble chloride of lead. After boiling, the acid is again filtered, and may now be concentrated in an open capsule below boiling until it attains a specific gravity of 1·6, or thereabouts, when it commences to give off white vapours. By distillation of this product an acid having the density of 1·693 is obtained.

One pound of perchlorate of potash yielded five ounces of acid of a density of 1·210.

The properties of perchloric acid have been so fully described by Professor Roscoe (vol. xxxiv., p. 64, of this journal), that further notice is unnecessary.

The effect of this acid, sp. gr. 1·693, was tried on the following articles: With morphia, codeia, narcotina, and atrophia; no reaction. With meconia, flesh colour; quinia, pale straw colour; strychnia, pale yellow; brucia, rose colour; delphia, a dirty red colour; aconitia, a light ochry yellow; digatalin, snuff brown.

Perchlorate of Morphia.—Dr. Ogden, in his analysis of chlorodyne, claims perchlorate of morphia as one of its ingredients. The following short notice of this salt are the results of some experiments made to ascertain its character:—It crystallises in long acicular prisms. Requires seventy-three parts of water, and forty-four of alcohol, at 60° F., for solution. In chloroform it is almost entirely insoluble.

On Ésérine, the Alkaloid of the Calabar Bean, by MM. A. Vée *and* M. Léven.*

The authors begin with pointing out that the *phytostigmine* of Jobst and Hesse only possesses some of the characters of an immediate principle, and is, in fact, a mixture of several bodies, of which the most considerable is a crystallisable body which they call ésérine. This is obtained in the following way, which, it is said, is a modification of the process of Stas for separating alkaloids in cases of poisoning.

Calabar beans reduced to a fine powder are exhausted by cold alcohol. The alcohol is carefully distilled from the tincture, and the extract is treated with a strong solution of tartaric acid. After some time the mixture is diluted with water, filtered and then supersaturated with bicarbonate of potash. The whole is now shaken with ether, and the etherial solution separated gives on evaporation the alkaloid contaminated with foreign matters. The extract is dried over sulphuric acid, and then re-dissolved in pure anhydrous ether, from which solution the alkaloid is obtained almost pure. Repeated solution in alcohol or ether remove all the impurities, but a little red colouring matter which obstinately adheres.

Ésérine is a crystallisable solid of a faintly bitter taste, which is not immediately perceived. It is freely soluble in ether, alcohol, and chloroform, and but slightly soluble in water. It crystallises in thin rhombic plates, which are coloured by polarised light. The aqueous solution has an alkaline reaction. The alkaloid is soluble in acids; the solution gives all the ordinary general tests for alkaloids. The solution acts powerfully upon the pupil.

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[*] Abridged from *Journal de Pharmacie, &c.*, January, 1865, p. 71.

PROCEEDINGS OF SOCIETIES.

PHARMACEUTICAL MEETING.

Wednesday, February 1.

Mr. Hills, *Vice-President, in the Chair.*

(Continued from page 69.)

Dr. Attfield communicated the results of an analysis of the kola nut. He sought first for theine. A decoction was precipitated by basic acetate of lead, excess of lead removed by sulphuretted hydrogen, and the clear solution left evaporated to dryness. The residue was digested in hot alcohol, and the alcoholic solution evaporated to small bulk. This, when cold, solidified to a mass of crystals, which were found to possess all the characters of theine. The amount of this body present in the kola nut is 2 per cent. No other acid, basic, or neutral body was found. The fresh nuts have a bitter taste, which the dried do not possess; and the former probably contain a bitter principle to which some of their activity must be ascribed. Starch is present to the extent of 42·5 per cent.; gum, sugar, and an albumenoid substance (probably legumin) are also found, and likewise a small amount of an oil possessing a smell resembling that of myrrh, and a burning, persistent taste. Tannin is entirely wanting in the nuts. The composition of the nuts is shown in the following table:—

	In 100 parts.
Water	13·65
Cell wall and colouring matter	20·00
Starch	42·50
Volatile oil Fixed fat	1·52
Albumenoid substance	6·33
Gum Sugar Other organic matter	10·67
Ash	3·20
Theine	2·13

Dry kola is thus seen to somewhat resemble coffee, but differs in containing no tannin, but little fat, and much starch. When made into a beverage, it is thick and mucilaginous; but is tasteless, odourless, and flavourless, and is not improved by roasting.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

January 24, 1865.

R. Angus Smith, *Ph.D., F.R.S., &c., President, in the Chair.*

Dr. R. Angus Smith, F.R.S., read a paper "*On some Physiological Effects of Carbonic Acid and Ventilation,*" of which the following is the substance:—That bad ventilation produces effects which are unpleasant, unwholesome, dangerous, or deadly, according to circumstances, has been long known; it has also been well known that the effects of breathing carbonic acid are of a similar kind. We have not, however, been able to say distinctly that the evil effects of bad ventilation are due entirely to carbonic acid. We have had, and not without good reason, a strong belief that the organic matter was a grave offender. The author had endeavoured to show elsewhere that the organic matter is in early stages of ventilation the most observable, but that in later stages the effect of the carbonic acid is unmistakeable. When inquiring into the state of the air in mines he found it needful to make experiments in close places, and had a leaden air-tight room built, containing about 170 cubic feet of air. On examining the effect of carbonic acid on the burning of candles, he remained in the chamber until that gas was poured in to the extent of 3·9 per cent. He then found that the pulse fell so low that it was difficult to count the beats, whilst they diminished in number. This effect was rapid, as he was not long in the room. Since there was no time for the accumulation of organic matter, nearly the whole effect must have been due to carbonic acid. Similar results were observed frequently. A few may be given. The first here adduced will show the fall of the pulse and the increase of the respiration more clearly than the others, as the details are appended. The carbonic acid increased by means of respiration only. The number of beats diminishes with a regularity equal to the increase of the carbonic acid, whilst the breathing quickens with equal steadiness.

ONE PERSON IN THE LEAD CHAMBER.

Respiration and beats of the pulse taken every ten minutes.

Time.	Pulse.	Respiration.	Temperature, Celsius.	Carbonic Acid in the same periods.
h. m. 10 55	73	15·5	deg. 18·2	0·04
min. After 10	73	16	18·2	0·114
„ 20	72	16	18·2	0·187
„ 30	71	17	18·4	0·261
„ 40	71	16	18·4	0·335
„ 50	70	16	18·5	0·408
„ 60	68	16	18·6	0·482
„ 70	67	16·5	18·7	0·556
„ 80	67	17	18·8	0·629
„ 90	66	17	18·9	0·703
„ 100	65	18	19·0	0·777
„ 110	65	18·5	19·0	0·850
„ 120	64	19	19·0	0·924
„ 130	63	19	19·2	0·997
„ 140	62	19·5	19·1	1·071
„ 150	62	20	19·1	1·145
„ 160	62	20	19·1	1·218
„ 170	61	20	19·1	1·292
„ 180	60	21	19·1	1·366
„ 190	60	22	19·2	1·439
„ 200	59	23	19·2	1·513
„ 210	58	24	19·4	1·587
„ 220	57	24	19·4	1·661
„ 230	57	24	19·4	1·734

Five persons sat for 80 minutes in the room. In all cases there was great irregularity of breathing. They were all conversing with each other, which occupation, as was found, somewhat modified the effect. In two cases the rise of the pulse was considerable—viz., from 60 to 79, and from 84 to 91; but the numbers soon fell down to the natural amount, and would apparently have fallen much lower if one of the two persons had not felt too unwell to remain. The pulses in all cases were difficult to count, being excessively feeble, and the most delicate of the fingers was sought for the operation. No deficiency of strength was found in any of the trials, and the amount of carbonic acid rose equally from first to last. As the pulse rose and fell according to the individuality, the author fixed on one young man on whom the effect was most regular for further experiment. It must be remembered, however, that on no person was the effect small or uncertain. The objects of the farther experiments were these,—1st, to inquire if the influence could be observed when the amount of carbonic acid was small; and 2nd, to separate the effects of the carbonic acid entirely from those of organic matter. With 3 per cent. of carbonic acid evolved in the chamber itself, the pulse fell in 27 minutes from 67 to 62, the breathing rose from 17 to 23; the pulse so low that it was barely perceptible. The exposure was not full 27 minutes, as the gas took some time to evolve. With 2 per cent. the pulse fell in 70 minutes 4, the breathing rose from 18 to 23½. On coming out the pulse rose 8 in five minutes. With 1 per cent. the pulse fell 4 in the hour. The following results were obtained by breathing air with carbonic acid entirely free from organic matter, the inspirations being taken from a prepared reservoir, and the expirations not being allowed to mix with them:—

With	1 per cent. CO_2	a rise of 2, then a fall of 5 beats of the pulse in 26 minutes.
„	0·5	pulse fell 5 in 40 minutes, respiration rose 7.
„	0·25	carbonic acid pulse rose 3 and fell 4 in 30 minutes, respiration rose 4.
„	0·1	carbonic acid rose 1 and fell 1 in 45 minutes, breathing rose 1.

Ordinary air was breathed in the same way, so as to eliminate the effect of the apparatus. Pulse rose 1 and fell 1, but no greater change occurred during a whole hour. Breathing continued unchanged except at one interval, when it fell 1 and then resumed its usual number. In no experiment during the whole period did the breathing of the same experimenter ever fall 1 when there was as much as $\frac{1}{10}$th per cent. of carbonic acid present. In one person, a youth, the pulse rose on every trial. On entering into the air with 3 per cent. of carbonic acid and no organic matter, his pulse rose 6 in two minutes and his breathing fell 4. The pulse was so feeble that he could not count it; some one helped in the process. He found the air very unpleasant. Another young man in two minutes in the same air, found that his pulse rose 6 and his respirations 4. The action of carbonic acid seems therefore, in all cases to enfeeble the pulse; at first sometimes to cause a rise, but finally to lower the number of the beats. This effect is instantaneous or nearly so with air having 3 per cent. of carbonic acid, but diminishes with the amount of impurity. It is, however, perceptible with an amount of carbonic acid as low as 0·1 per cent, and probably by taking long periods the effect would be found even with smaller quantities. This amount is often exceeded in private houses and public meetings, where it rises to 0·2 or even 0·3. The second effect of carbonic acid is in the breathing, which it hastens rapidly, although in some cases it causes a diminution of the inspirations. The effect approaches either a gasping or a panting. The author added that he must leave to physiologists to speak of the ultimate effect of such a condition of things, and would only observe, that in Dr. Peacock's inquiries into the state of health of the Cornish miners, he found that a feeble pulse was one of the peculiarities, a proof that the temporary results found in these experiments may be rendered permanent. On coming into fresh air the pulse and breathing recovered in a few minutes, showing the value of ventilation.

ACADEMY OF SCIENCES.

February 6, 1865.

At the last sitting of the Academy the reports of the various commissioners were read, and announcement made of the prizes awarded. The Jecker prize was awarded to M. Wurtz for his last studies on the alcohols. The Lalande prize was adjudged to Mr. Carrington, of Redhill, for his "*Observations on the Solar Spots from the 9th of November, 1853, to the 24th of May, 1861.*"

NOTICES OF BOOKS.

On Acting and Kindred Subjects Considered in Relation to Genius and Talent. Also on Theories of Chemistry. London: J. and F. C. Matthieson. 1865.

We are always glad to meet with a chemist who is something more than a chemist; for a man of one science is as great a bore as the dreaded *homo unius libri.* We must confess, however, that we have read this little book with more pain than pleasure. We feel satisfied that the author will one day regret that he has printed it, and therefore it is a charity to hope for him that nobody will read it.

Annales de Chimie et de Physique. January, 1865.

This journal is, for the most part, made up of papers which have appeared at length or in abstract in the *Comptes-Rendus* of the Academy, and which have, therefore, been noticed already. The reader will find here at full length the valuable researches of MM. Bussy and Buignet "*On the Changes of Temperature produced by the Mixture of Liquors of Different Natures;*" also, the memoir of M. Dumour "*On Callais,*" and that of M. Le Guen, "*On the Effects of Wolfram in Cast-Iron Guns.*" Besides, there is an interesting memoir for electricians by M. Crova, "*On the Laws of the Variation of the Electromotive Force in Piles with one Liquid.*" We also find an account of some "*Chemical Researches on Germination,*" by M. Fleury. The object of the author's researches was to determine the part played by the fatty matters in seeds in which these matters accumulate; and those he experimented upon were castor and colza seeds, sweet almonds, and the seeds of *Euphorbia lathyris.* We cannot here notice his analytical methods, and now only refer to the general results. The author finds that the use of the fatty matters is not only to furnish respiratory matter during germination, but also to yield new materials which the plant requires for its growth. The first change of the fat is into sugar or dextrine, which then becomes organised into cellulose. This stage sometimes passes so rapidly that it is difficult to fix the preceding change. The oxygen of the air burns the excess of carbon and hydrogen in the fats to bring them to the composition of the carbohydrates—dextrine, sugar, and cellulose; and sometimes goes further, oxygen being fixed on the fatty matter. In fact, the author finds that a given weight of oily seeds always acquires oxygen in the course of germination. M. Fleury also shows that fat disappears more rapidly from germinating seeds than from the bodies of starving animals. He thought it unnecessary to look for any catalytic agent susceptible of causing the transformations, considering that the play of chemical affinities under vital influence was sufficient to account for the changes. M. Dupré continues his second memoir "*On the Mechanical Theory of Heat.*"

Journal de Pharmacie et de Chimie. January, 1865.

The *Journal* opens with a *resumé* of the proceedings of the Paris Pharmaceutical Society in 1864, by the Secretary of the Society, M. Buignet. It gives an excellent account of the principal discoveries in chemistry and pharmacy made in France during the past year, in which, however, we find nothing which has not been laid before our readers. We may say the same of the greater part of the contents of this number of the *Journal;* but in the medical review we find a notice of the "*Chemical, Physiological, and Therapeutic Properties of Iodoform*" by Dr. Righini, which seems to show that this body may be a valuable therapeutical agent; and for this reason we shall translate the paper. Another paper deserves a further notice—"*On the Alkaloid of the Calabar Bean*" by MM. Vée and Leven. The authors show that the phytostigmine of Jobst and Hesse is a mixture of several bodies, including a crystallisable body, ésérine, which they regard as the true active principle. We give in another place the method of extracting this body.

Chemisches Central-blatt, Nos. 3 and 4. 1865.

In noticing these journals we can only remark again that, with one exception, all the papers of interest have been already noticed in our pages. The exception is a paper by Dr. Lermer, "*On the Chemical Resistance of Lead and its Alloys with Tin to the Vapour of Water.*" From the Doctor's experiments it appears that pure lead is strongly attacked by the vapour of water, but on the addition of tin the action rapidly decreases. With equal parts of lead and tin, the action is only about one-tenth of what takes place with pure lead. An alloy containing 37 per cent. of lead is scarcely at all attacked. The author also shows that pure tin does not altogether resist the vapour of water. These facts are of some importance to the manufacturers of distillatory apparatuses.

In No. 4 we find an account of the proximate constituents of the seeds of *Lolium temulentum,* by Ludwig and Strahl, in which, however, they do not seem to identify the poisonous principle. They remark the presence of four different fatty matters, and a bitter principle, soluble in ether and spirit, as well as the usual ingredients of the seeds of the Gramineæ. We find here, too, a short notice of "*A Method of Separating Quinine from Cinchonine Salts,*" by R. Palm. The author adds a boiling solution of the two salts to a solution of pentasulphide of potassium. Cinchonine is thus separated as a white powder, mixed with sulphur; the quinine, on the contrary, separates as a white resinous mass, which becomes hard on cooling.

NOTICES OF PATENTS.

1374. *Improvements in the Mode of Heating Animal, Vegetable, and Mineral Matters whereby to Effect their Desiccation, Vaporisation, Decomposition, Reduction, Fusion, &c.* W. Clark, Chancery Lane, London. A Communication. Dated June 2, 1864.

For the purpose of conducting the distillation of all classes of substances included under the comprehensive definition set forth in the title, the patentee claims a mode of heating them in close vessels whereby the volatilised products given off are themselves made the medium or vehicle for the application of the necessary degree of heat to fresh portions of the substances under treatment. In a similar manner various processes of desiccation, fusion, reduction, and decomposition are intended to be carried out, with the object of obtaining superior products by the least possible consumption of fuel.

The principle of this invention seems to be very similar to, if not identical with, the system of using heated permanent gases, which was patented two days earlier by Mr. J. Young, of Bucklersbury, a notice of which appeared at page 71 of our last number.

1375. *Processes and Apparatus for Treating Alkaliferous Minerals to obtain Alkalies, Alkaline Salts, Alumina, and Accessory Products.* F. O. Ward, Hertford Street, Mayfair, London. Dated June 2, 1864.

In order to liberate potash and soda from felspars and other minerals containing these alkaline bases, and to procure at the same time alumina or its compounds, the inventor fuses such minerals with fluoride of calcium with or without the addition of lime, whereby soluble alkaline salts are produced.

The use of the same flux was patented by Mr. F. O. Ward on the day previously for the reduction and treatment of the very refractory ores of chromium, and this appears to be but a modification of a former patent by the same gentleman.

1387. *Treating Petroleum and its Products.* B. AZULAY, Rotherhithe. Dated June 3, 1864.

FOR the disinfection of crude petroleum, the patentee employs an aqueous solution of chloride of lime, which is brought into more thorough contact with the oil by the employment of pumps and frequent agitation.

1390. *Purifying or Refining Oils.* F. TOLHAUSEN, Paris. A communication. Dated June 4, 1864. (Not proceeded with.)

IN the treatment of all kinds of raw oil the inventor proposes to mix them with nitric and sulphuric acids, and to add camphor and paraffine. The action is assisted by the employment of a moderate heat.

1401. *Separating certain Metals and Metallic Substances from Ores, &c.* J. NAPIER, Glasgow. Dated June 6, 1864.

THIS specification describes, in the first place, a mode of subliming metallic substances of a volatile nature by the application of heat, particularly that of superheated steam, hot air, or other suitable gas, to ores or crude mixtures containing such metals or metallic compounds. The second claim refers to the reduction of products obtained in the manner before mentioned, or of natural products containing metals, by submitting these substances to the action of heated gases, which are capable of combining with or other separating the associated element or elements.

1404. *Clearing Away and Removing Sand, Mud, or other similar Accumulations, from Dock and Canal Entrances, the Beds of Rivers, &c.* G. MEZOTTI, Upper Seymour Street, Euston Square. Dated June 6, 1864. (Not proceeded with.)

THIS proposal is directed to the removal of accumulations of sand or mud by the employment of force pumps, whereby a current of air or water is made to pass through hose or pipes to the immediate neighbourhood of the deposits, which are in this way caused to become suspended in the water, and then are easily got rid of by taking advantage of tidal currents or artificial expedients having a similar tendency.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by MR. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

1876. A. G. Hunter, Rockcliff Hall, Flintshire, "Improvements in the manufacture of soda and potash."—Petition recorded Nov. 17, 1864.

56. B. W. Bentley, Buxton, Derbyshire, and W. H. Bailey, Salford, Lancashire, "Improvements in producing and finishing photographs and photographic transparencies on paper and other suitable substances, and in the machinery employed therein."—Jan. 7, 1865.

72. E. Pettitt, Birmingham, Warwickshire, "Improvements in giving permanence to and in ornamenting glass transparent positive photographs."—Jan. 10, 1865.

103. M. Henry, Fleet Street, London, "Improvements in furnaces."—A communication from D. Chràdo, Turin. —Jan. 12, 1865.

110. W. S. Longridge, Alderwasley Iron Works, Derbyshire, and James Mash, Bowden, Cheshire, "Improvements in furnaces."—Jan. 13, 1865.

112. A. J. Sax, Paris, France, "Impregnating air for hygienic or therapeutic purposes with the vapours or emanations arising from tar, creosote, or other suitable liquid antiseptic or anti-putrid substances, or disseminating in the air for the said purposes suitable pulverised substances."—Jan. 13, 1865.

119. G. Davies, Serle Street, Lincoln's Inn, "A method of, and apparatus for, preventing incrustation or calcareous deposits in steam-boilers."—A communication from A. F. Porter, Philadelphia, U.S.A.—Jan. 16, 1865.

140. R. A. Brooman, Fleet Street, London. "Improvements in treating phosphates of lime and salts of potass and soda in order to fit them for agricultural uses."—A communication from G. Ville, Paris, France.—Jan. 17, 1865.

173. J. Hewes, West Bromwich, Staffordshire, "Improvements in puddling, heating, and other reverberatory furnaces used in the manufacture of iron and steel, and for other purposes, which improvements may also be applied to steam boiler furnaces."

176. B. F. Stevens, Henrietta Street, Covent Garden, Middlesex, "Improvements in vulcanising compounds and vulcanised fabrics."— A communication from S. Stevens, New York, U.S.A.—January 20, 1865.

194. E. Atkinson, Old Bond Street, Westminster, "An improved apparatus for containing and dispersing scents and other liquids."

201. A. M. Dietz, St. Paul's Buildings, London, "Improvements in petroleum and coal oil burners and glasses."

202. B. King, Ipswich, Suffolk, "Improvements in the manufacture of manure."—January 23, 1865.

206. J. Rovère and H. A. B. Huguet, Rue de Malte, Paris, France, "A new electric pile."

207. G. Haseltine, Southampton Buildings, Middlesex, "Improvements in the mode of, and means for preserving fruit and other eatables."—A communication from B. M. Nice, Indianopolis, Indiana, U.S.A.

209. W. Woodward, R. Woodward, J. Woodward, and A. Woodward, jun., New Islington, Manchester, Lancashire, "Improvements in furnaces for melting metals and smelting ores."—January 24, 1865.

226. A. A. Croll, Coleman Street, London, "Improvements in the purification of coal gas."

227. H. W. Ripley, Lightcliffe, near Halifax, Yorkshire, "Improvements in colouring kempy wool and hair."

229. J. G. Williams, St. Stephen's Crescent, Bayswater, Middlesex, "Improvements in the manufacture of iron and steel."—Jan. 26, 1865.

244. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the treatment of oils obtained from the distillation of tar, and in the application of the same to the purposes for which ordinary drying oils are applicable." A communication from C. Cordier and V. Cordier, Paris, France.—Jan. 27, 1865.

246. G. Haseltine, Southampton Buildings, Middlesex, "An improved process of manufacturing syrup and sugar from maize starch, and other cereal grain starch." A communication from F. W. Goessling, Buffalo, New York, U.S.A.

250. W. E. Newton, Chancery Lane, Middlesex, "Improvements in the rectification of alcohol, and in the apparatus to be employed therein." A communication from A. A. Foubert, Rue St. Sebastien, Paris, France.

256. A. S. Macrae, Liverpool, Lancashire, "Improvements in lanterns for burning hydro-carbon fluids."—Jan. 28, 1865.

259. J. McInnes, Liverpool, Lancashire, "A metallic anti-corrosive varnish for protecting the surfaces of metals from oxidation."

261. W. Teall, Wakefield, and A. Naylor, Bradford, Yorkshire, "Improvements in means or apparatus for extracting or expressing oil or grease from the greasy waste of fibrous substances, or other substances containing oil or grease."—Jan. 30, 1865.

269. R. A. Brooman, Fleet Street, London, "Improvements in rail and tramways, in laying electric telegraph wires, and in compositions for coating the same." A communication from J. A. E. Laloubère, Paris, France.

270. W. H. Cox, Bermondsey, Surrey, "Improvements in tanning hides and skins, and in apparatus employed therein."—Jan. 31, 1865.

NOTICES TO PROCEED.

2329. T. and T. F. Walker, Birmingham, Warwickshire, "Improvements in means or apparatus for the utilisation of sewage matters, part of which improvements is applicable to raising and forcing other fluids."—Petition recorded Sept. 22, 1864.

2336. M. Henry, Fleet Street, London, "Improvements in dyeing and tanning, and in preparing for dyeing and printing."—A communication from F. V. A. Autier, Paris, France.—Sept. 23, 1864.

2387. T. J. Denne, Mile End, Middlesex, "An improved method of protecting the sides and bottoms of iron ships and other submerged iron structures."—Sept. 28, 1864.

2522. E. Moride, Nantes, France, "Improvements in the treatment of sea wrack grass for the extraction of the carbon and the salts contained therein."—Oct. 13, 1864.

2552. W. Clark, Chancery Lane, Middlesex, "Improvements in the preparation of artificial wax."—A communication from J. Montier and others, Boulevart St. Martin, Paris.—Oct. 15, 1864.

2428. R. A. Brooman, Fleet Street, London, "The manufacture of a substitute for albumen." A communication from C. Kestner, Thann, France.—Oct. 3, 1864.

2487. J. Cassell, La Belle Sauvage-yard, London, "Improvements in treating coal, peat, shale, wood, and ligneous products, and in obtaining fuel, oil, and other products therefrom."—Oct. 10, 1864.

2634. W. Clark, Chancery Lane, Middlesex, "Improvements in apparatus for concentrating and distilling sulphuric and other acids, and all solutions in general." A communication from E. A. Cotelle, Boulevart St. Martin, Paris.

2635. G. T. Bousfield, Brixton, Surrey, "Improvements in manufacturing aërated bread by the application of carbonic acid gas obtained from fermenting vegetable matters, and in the apparatus employed therein." A communication from S. T. Bacon, Boston, U. S. A.—Oct. 24, 1864.

3045. E. T. Hughes, Chancery Lane, London, "Improvements in treating aniline colours for dying and printing." A communication from A. S. L. Leonhardt, Berlin, Prussia.—Dec. 17, 1864.

3093. C. Hancock, West Street, Smithfield, and S. W. Silver, Bishopsgate Street, London, "Improvements in colour printing."—Dec. 14, 1864.

3184. R. L. Howard, Upper Whitecross Street, Middlesex, and John Dauglish, Reading, Berkshire, M.D., "Improvements in apparatus for making aërated bread." —December 22, 1864.

3215. W. E. Gedge, Wellington Street, Middlesex, "An improved apparatus for administering douches and injections with continuous and continual jet."—A communication from J. Salamon, Faubourg St. Martin, Paris, France.—Dec. 27, 1864.

3229. J. D. Morrison, Weary's Place, Edinburgh, N.B., "Improvements in painless dentistry by apparatus for cooling and tempering air and applying it as an anæsthetic agent."—Dec. 29, 1864.

CORRESPONDENCE.

Continental Science.

PARIS, February 14.

THE Academy of Sciences has awarded the Lalande medal, the highest astronomical prize in the gift of the Academy, to Mr. Richard Carrington, of Redhill, the indefatigable observer of solar spots. I mention this with pleasure, for among the members of the Academy it must be admitted that there are some manifestly afflicted with Anglophobia.

Among the many improvements in photographic apparatus one of the most important is that made recently by M. Dubroni. He has contrived a most complete set of apparatus which a photographer on his travels can almost put in his pocket, and by means of which ladies can practise the art without risk of soiling their fingers. His camera is a small box of yellow glass, and within this all the operations which it is necessary to perform beyond the reach of actinic light are effected by the use of very simple contrivances. After the collodion has been applied to the plate, it is fixed in its place in the camera, and the sensitizing solution is conveyed to it by means of a glass pipette furnished with an india-rubber bulb. When a good coating is obtained, the excess of nitrate of silver is sucked up by the same pipette, and returned to the bottle. After exposure the developing solution is conveyed to the plate in the same way with another pipette. To avoid mistakes, M. Dubroni makes the pipette for applying the nitrate of silver of blue glass and that for the developer of red glass. The fixing and washing are, of course, carried on outside the camera. The only difficulty I see is in preventing the access of light by the opening in the top of the camera through which the pipettes are passed down to the plates: the inventor, however, seems to have avoided this. You will no doubt have the apparatus in London soon, so I need not describe it more particularly.

A little medical news will have some interest, or at all events some amusement, for your readers. An old *pathy* is just now being revived in Paris. *Metallopathy* was much practised here five-and-twenty years ago, but has been almost forgotten, although occasionally referred to by great names. It means the cure of nervous affections by the application of metallic plates to the seat of pain. Besides the immediate relief of pain, other wonderful effects are reported to follow the application of the metal, but I need only mention the former most important result. The reviver of the practice is Dr. Dufraigne, who relates the following extraordinary cure:—He had invited a dinner party, and among the guests was a lady, who, just as the company were about to sit down, was seized with a violent headache. A happy thought struck the doctor. He sent for the cook, who came with a copper stewpan, which the doctor held to the lady's forehead for ten minutes, after which she was perfectly cured, and sat down to her dinner as lively as the rest. A second attack at home some days later was cured in the same simple way.

The relative advantage of ether and chloroform as anæsthetics is now being again discussed. In Naples, ether is preferred, and it is used in a peculiar way. Some of the fluid is poured upon rags in a bag or bladder, and from this the patient takes large and frequent inspirations. Insensibility very soon ensues, and is attended, it is said, with no danger, although the ether vapour is inhaled almost without air. In Paris, also, it seems to be believed that the use of chemically-pure ether is quite free from all danger, which is more than can be said for chloroform.

Some of the works on experimental physiology and medicine which have been rewarded by the Academy of Sciences will be found well worthy the attention of physiologists and medical men, particularly that of M. Sapey "On the Structure of the Ovary," and M. Zenker "On the Trichina Disease."

The Sugar of the Future.

To the Editor of the CHEMICAL NEWS.

SIR,—Dr. Adriani, in translating Dr. de Vry's note to him, renders Indian cane *Canna indica*, a starch-producing plant, but certainly not one of the plants cultivated for sugar; it should be the *Beta vulgaris* and *Saccharum officinarum*. I fear Dr. de Vry has scarcely looked into the statistics of sugar consumption in Europe and America, or he would find that thousands of acres planted with the Arenga palm would go but a very small way towards supplying one tithe of the quantity required annually. All the palm-sugar that could be produced in India and the East would find a ready local consumption. Another error Dr. de Vry falls into is, that land employed for the production of the sugar-cane in the tropics ought to be applied to the culture of rice. Does he not know that rice is a semi-aquatic plant, the quantity of hill or upland rice grown being very small, whilst the sugar-cane luxuriates in a deep rich loam or clayey soil?—I am, &c.

P. L. Simmonds.

The Jury Reports.

To the Editor of the Chemical News.

Sir,—An error in my letter on the subject of the Jury Reports of the Exhibition of 1862 has led your correspondent, "A Chemist," into making a charge against the Society of Arts which has no foundation in fact. Messrs. Bell and Daldy, the publishers of the Reports, inform me that each and every Report was on sale separately to the public.—I am, &c. P. Le Neve Foster.

Society of Arts, Manufactures, and Commerce, John Street,
Adelphi, London, W.C., February 8.

[In reply to the above, we must state that we ourselves sent repeatedly to Messrs. Bell and Daldy for the Report on Class II., Section A., and at last, when we knew it was in circulation, were, as we thought, distinctly informed that there were none for sale separately.—Ed. C. N.]

Production of Ammonia.

To the Editor of the Chemical News.

Sir,—In your impression of January 20 you transcribe a notice of some experiments by M. Dechame on the production of ammonia by the action of "arable soil" upon atmospheric air. Now, this is a subject which I have most attentively studied (although not without frequent intermissions) for several years past, and so interesting have been my results that I hope to publish them in detail next season, if not during the present one.

I have produced ammonia in no (comparatively speaking) inconsiderable quantity, under various circumstances, directly from air and water by the interposition of certain earths, soils, and marls, at varying temperatures. But, as whenever a "vegetable earth" or "soil" of any kind is employed the result cannot be depended upon as rigidly and analytically correct, however carefully the experiments may have been conducted, I have also followed another plan.

De-ammoniated air (I use the term for the sake of brevity), when passed over small nodules of pumice-stone about 0·1 to 0·2 inch in diameter, and moistened with either pure water or dilute solutions of certain salts, always gave me, with proper precaution, evidences of the formation of ammonia. Sometimes peroxide of hydrogen is also produced. When the prepared pumice-stone is moistened with a very dilute solution of pure neutral chloride of sodium the formation of ammonia is materially accelerated, and other substances modify the results in different ways.

It would be useless at the present moment to occupy more of your space by going deeper into the subject, but I may ask you for "a few columns" hereafter.

In the same number of your journal I also notice a self-registering maximum thermometer,* and from the *Comptes Rendus* an account of a thermometrical fire alarum.†

Without wishing in the slightest degree to detract from the merits of Mr. Twining's sounding apparatus, I may observe that his thermometer is identical in principle and construction with an experimental one of my own, which some years ago I fully tested and condemned as utterly untrustworthy for sounding purposes. Spirit thermometers in every form were objected to by the Society of Arts' committee appointed to investigate the matter, and the society's silver medal was awarded to me in 1858 for my "compensation" mercurial maximum thermometer, an illustrated description of which has already appeared in these pages. Up to the present time there has appeared, I believe, no other instrument of such definite accuracy, whether in a state of repose or violently agitated, no moveable indices whatever being employed in my thermometer.

By modifying the construction slightly, I have produced an "electro-thermometrical alarum"—which, owing to the loss of some papers, &c., through the post, was not exhibited at the last meeting of the British Association—capable of being "set" so that any specific rise or fall of temperature, from 0·1° to 300° or 400°, will cause the alarum to act; thus the instrument can be employed for a green-house one day, for a boiler the next, and for a delicate chemical or physiological experiment on the following with equal accuracy and facility. It will be exhibited shortly. I am, &c.

Wentworth L. Scott, F.C.S., &c.

Westbourne-park.

Combustion in Carbonic Acid.

To the Editor of the Chemical News.

Sir,—I am not sure that the subjoined experiment is important or new, but I have not found it recorded, and it seems a suitable illustration for the lecture table.

It is known that heated potassium will decompose carbonic anhydride, burning in the gas with extrication of carbon $CO_2 + K_4 = C + 2K_2O$.

I find that ignited magnesium wire will similarly burn with some brilliance in CO_2, but without the liberation of any carbon; the reaction is probably, therefore, a less complete deoxidation—$Co_2 + Mg = CO + MgO$. The solid results of the combustion are magnesia and carbonate of magnesia, and the resulting gas contains CO, as determinable by cuprous chloride.

The experiment is eminently contradictory of popular and preconceived notions respecting combustibles and supporters of combustion, for herein a metal burns in a gas which is neither combustible nor a supporter of combustion, and produces a combustible gas.

The similar actions of iron and zinc upon CO_2 are mentioned in text-books, but are less easily capable of demonstration. I am, &c.

B. W. Gibsone, F.C.S.

February 13.

MISCELLANEOUS.

Pharmaceutical Society.—The next Pharmaceutical meeting will be held on Wednesday, March 1, when Dr. Redwood will read a paper "On the Preparation of Nitrous Ether and Sweet Spirit of Nitre."

Royal Institution.—The following are the arrangements for the ensuing week:—Tuesday and Thursday, February 21 and 23, at 3 o'clock, Professor Tyndall, F.R.S., "On Electricity." Friday, February 24, at 8 o'clock, John Evans, Esq., F.R.S., "On the Forgery of Antiquities."

Beef at Threepence per Pound.—On Tuesday last we attended at the London Tavern, and made trial of various dishes prepared from the beef imported by the South American Beef Company. Of the soups we may speak in the highest praise, and the curries were not to be despised. The *bouilli*, the least satisfactory of the dishes, was scarcely inferior to what we have eaten at continental *tables d'hôte*. We hope this entertainment will

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* Mr. F. Twining "On Appliances for Taking Deep Soundings."

† "Thermometer Alarum," page 35.

serve to dissipate all the doubts which various people have held as to the possibility of making the beef palatable as well as nutritious. It simply requires time and care in cooking. We must add that the Company now supply the beef in powder, or ground with peas, so that strong, highly nutritious soups can be prepared without the trouble of long boiling.

Chlorodyne.—The following recipe will furnish a preparation having the pharmaceutical properties of chlorodyne, according to Dr. Ogden:—℞. Muriate of morphia, grs. viii.; water, fl. ʒss.; perchloric acid (25° B.), gtt. xx.; chloroform, fl. ʒjss.; tinct. of Indian hemp, fl. ʒj.; hydrocyanic acid (U. S. P.), gtt. xii.; molasses, fl. ℥ss.; oil of peppermint, gtt. ij.; oleoresin of capsicum, gtt. i. To the morphia and water in a small flask, add the perchloric acid, and heat until a clear solution is obtained; then add the molasses, previously warmed to render it fluid. Heat the mixture, and agitate well. When cold, add the other ingredients, and mix thoroughly.—*American Journal of Pharmacy.*

Test for Rum.—Dr. Wiederbold proposes the following method for distinguishing between true rum and the factitious liquids sold under this name:—Mix a little of the rum to be tested with about a third of its bulk of sulphuric acid, and allow the mixture to stand. If the rum is genuine its peculiar odour remains after the liquid has cooled, and even after twenty-four hours' contact may still be distinguished. If, on the contrary, the rum is not genuine, contact with sulphuric acid promptly and entirely deprives it of all its aroma. The author affirms that he had never found this very simple process fail, and that all spurious rums may thus easily be distinguished from the genuine.—*Report de Pharmacie.*

Report on the Patent Laws.—The following are the recommendations with which the commissioners sum up their investigation into this important subject:—"1. Your commissioners do not find that the present cost of obtaining letters patent is excessive, or the method of payment inconvenient. They do not, therefore, recommend any alteration of the present system on those points; but they think that patent fees should not be made to contribute to the general expenditure of the State until every reasonable requirement of the Patent Office has been satisfied. 2. They are unable to recommend a preliminary investigation into the merits of the invention for which a patent is claimed; but they advise that a careful inquiry be instituted, under the direction of the law officers of the Crown, as to whether there has been any previous documentary publication of the intention, either by grant of letters patent or otherwise; and if such publication have taken place, that the patent shall be refused. No evidence other than such documentary evidence should be admissible, and the reasons for the refusal to grant the patent should be certified by the law officers; an appeal from their decision should lie to the Lord Chancellor. 3. Your commissioners are of opinion that the present mode of trying the validity of patents is not conducted in a satisfactory manner. That such trials ought to take place before a judge sitting with the aid of scientific assessors, but without a jury, unless at the desire of both parties to the suit or action. That such assessors ought to be selected by the judge in each case, and the remuneration to be paid them be included in the costs of the suit or action, and provided for in such manner as the judge shall direct. That no special judge be appointed for the trial of patent cases, but the judges of law and equity be empowered to make rules by which one court should sit for trial of patent cases exclusively. That on such trial the judge, if sitting without a jury, decide questions of fact as well as of law. 4. That the granting of licenses to use patented inventions ought not to be made compulsory. 5. That patents ought not to be granted to importers of foreign inventions. 6. That in no case ought the term for which a patent is granted to be extended beyond the original period of 14 years. 7. That in all patents hereafter to be granted a proviso shall be inserted to the effect that the Crown shall have the power to use any invention therein patented without previous licence or consent of the patentee, subject to payment of a sum to be fixed by the Treasury. 8. While, in the judgment of the commissioners, the changes above suggested will do something to mitigate the inconveniences now generally complained of by the public as incident to the working of the patent law, it is their opinion that these inconveniences cannot be wholly removed. They are in their belief inherent in the nature of a patent law, and must be considered as the price which the public consents to pay for the existence of such a law. Two of the commissioners, Mr. Hindmarsh and Dr. Fairbairn, do not concur with all these recommendations. Both these gentlemen think that under some circumstances the patent should be extended beyond the original fourteen years. Mr. Hindmarsh further recommends that no patent should be granted for an invention until a specification of it, containing a clear and distinct statement of the claim or claims made by the inventor, has been filed in the Patent Office, and that the sufficiency of all claims in specifications should be ascertained and certified by competent persons appointed to perform that duty. He also recommends that a petitioner should have the right of appeal if a patent be refused by the law officer.

Queen Mary on the Sale of Poisons.—The recent letter of the Queen to the directors of railway companies recalls to our mind the letter of another Queen—Mary of evil memory—to the College of Physicians, requesting them to carry out more efficiently the Act 32 Henry viii., c. 40, and also to "call and convent" before them "the Wardens of the Grocers and al the Apothecaries," and "streightly to charge and commande by authoritie that from tyme to tyme hensforthe neither thei nor anye of them do entreprice to sell or retayle any such wares, drugge or druggs as hath in theim any spice of venome or suspicion of poyson, or such other as by receivying of them at the handes of anie unlerned or of anie malitiouse or evyll disposed persons maie by anie means grievously hurte or put in perille or daunger of lief anie of our Subjectes of what estate or degre soever he or thei be, Onlesse the seller of any of the said druggs be well assured of the honestie, true dealying and good intent and skill of the byar; And first examyn the same for what intent or purpose he buyeth the same, and therewithal to note the name of the byar and time of the buying; Or else that the said grocer or apothecarie have with him remaining the handwriting of some discrete, lerned and authorised Physician for his discharge. Willing and streightly commandyng the said grocers and apothecaries and every one of them not to faile herof as thei tendre our pleasure &c &c. Given under our Signet at our Manor of *St. James* the xxiii daye of *June* in the fourthe and fivethe years of our reignes" (1557). The above appears to be the first suggestion of a Poison Act in England.

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the EDITOR, and *Advertisements* and *Business Communications* to the PUBLISHER, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. *Private* letters for the Editor must be so marked.

Mr. C. N. Ellis suggests that animals might be slaughtered by means of a violent shock of electricity.

T. W.—The errors are in the originals.

Pharmakon.—We know of no mechanical means of separating the gases.

F. W. P.—We have never met with the article.

Studiosus.—Boil the solution, and the sulphur will collect in a mass.

C.—By means of proto-nitrate of palladium.

Received.—Dr. Adriani, "On Cotton-seed Oil." Shall appear next week

THE PATENT LAWS.

The summary we published in our last number will have informed our readers of the alterations that the Commissioners appointed two years ago to investigate the subject, recommend to be made in our Patent Laws. These alterations are not many, but some are of considerable importance. With regard to the cost of obtaining a patent, the Commissioners appear to consider no change necessary. Many will be dissatisfied with this decision; the fees at present exacted are an insuperable barrier to the poor inventor; but higher charges might, perhaps, deter the crowd of speculators whose patents are the greatest sources of annoyance and perplexity alike to manufacturers and real originators. A suggestion as to the application of the fees deserves the highest commendation. The Commissioners recommend that no part of them should be contributed to the general expenditure of the State until all the requirements of the Patent-office, library, and museum, are fully satisfied. At present the surplus is about 40,000*l.* per annum; a fact which makes the establishment in Chancery-lane appear perfectly disgraceful to the Government. We shall say no more on this point at present, but at some future time we may point out several ways in which some of this surplus may be expended to the credit of the Government, and the better information of the people.

The Commissioners do not recommend that any preliminary investigation should be made into the *merits* of a patent, but they do advise that a careful inquiry should be instituted as to whether there has been any previous documentary publication of the invention, either by letters patent or otherwise; in other words, they recommend that the novelty of an invention should be strictly inquired into. We must confess ourselves a little puzzled by the words "documentary or otherwise." A book or journal, we imagine, is not a document in a legal sense; and if only documentary evidence is to be admitted, we fear it will still be open to an enterprising man to patent some specific application of a general process which has been described in a dozen journals or books, and to which in reality he has not the smallest claim.

The most radical alteration proposed is in the mode of trying the validity of patents. The Commissioners (a majority of them lawyers) have conceded that in these actions the judge should be assisted by scientific assessors. The need of this has been made evident many times. It is no disgrace to a profound lawyer that he is not at the same time an accomplished chemist or a well-informed engineer, and it is placing a man in an utterly false position to require him to decide on questions he cannot fully understand. We can, indeed, imagine it painful to listen to the rambling judgment or summing up of an upright-minded man, severely bent on doing justice, who meanders through the scientific evidence, making snatches here and there for the real points at issue, which seem to dance about in the foggy atmosphere around him like will-o'-the-wisps, continually eluding his grasp, and to find him at last guided to his decision rather by some instinctive sense of right than by any clear insight into the matters in dispute; or, perhaps resting upon some small technical point which saves him the trouble of going further after the broader issues. But then comes the question of the assessor, for a scientific jury is out of the question when every man of science may be subpœnaed on one side or the other. On this point we must be silent. "Sufficient for the day is the evil thereof."

Of the other alterations proposed by the Commissioners we need not speak; but a few words must be said in approval of a suggestion made by Mr. Hindmarsh. This gentleman has, perhaps, had more experience in patent cases than any other member of the bar, and what he says on the subject deserves attention. He recommends that a complete specification should always be filed with the petition. Of the propriety of this there can be no doubt. Every one will remember instances in which a painstaking inventor has carefully worked out his invention, and when he has completed his work has discovered that some one else has been to the Patent Office before him with a crude specification which effectually deprived him of the fruits of his labours. An idea may occur to many men at the same moment; but that man should be rewarded whose ingenuity and industry first reduce the idea to practice.

In conclusion we may quote the final words of the Commissioners:—"While," they say, "in the judgment of the Commissioners, the changes suggested will do something to mitigate the inconveniences now generally complained of by the public as incident to the working of the patent law, it is their opinion that these inconveniences cannot be wholly removed. They are in their belief inherent in the nature of a patent law, and must be considered as the price which the public consents to pay for the existence of such a law."

This is no doubt true. There must be inconveniences; but it should be the object of the Legislature to *minimise* (to use the expression of Jeremy Bentham) these inconveniences to the smallest possible point. The object of a patent law is simple enough. It is to ensure a reward to an inventor. Let the Legislature, then, take care, as far as it is possible, that only an inventor is rewarded.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

An Introduction to Chemical Philosophy, according to the Modern Theories, by Adolphe Wurtz, *F.R.S.*

Part I.

Equivalents, Atomic Weights and Molecular Weights.

Section I.—*Historical Development of the Ideas, Equivalent, Atom, Molecule.*

(Continued from page 73.)

Law of Gay-Lussac.—Difference between Atoms and Equivalents.—In the early part of this century most chemists recognised the fact both of definite proportions and of multiple proportions. Some stopped there, and by preference used the terms *equivalents* or *proportional numbers;* whilst others, advocates of Dalton's theory, assumed that the proportional numbers represented the relative weights of the atoms, and called them *atomic weights.* But the terms equivalents and atomic weights had then the same meaning: they represented the same proportions. According to Dalton, as seen by the table just given, water was composed of one atom of hydrogen (1) and one atom of oxygen (7), whilst according to Wollaston it was formed of one equivalent of hydrogen and one equivalent of oxygen.

In reality the two words meant one and the same thing: the true atomic theory was not yet conceived.

And yet in Wollaston's time the facts had already been discovered which should have led chemists to separate these two ideas one from the other. In 1808 Gay-

Lussac propounded his memorable laws of the combination of gases by volume. After having found in 1805, with A. de Humboldt, that hydrogen and oxygen would combine in the exact proportion of two volumes of the first gas to one volume of the second, he generalised from these observations, and showed that there exists a simple relation not only between the volumes of two gases which combine, but also between the sum of the volumes of gas which enter into combination and the volume which this combination occupies when in the gaseous state. Thus:—

I. Two volumes of hydrogen combine with one volume of oxygen to form two volumes of aqueous vapour.

II. Two volumes of nitrogen combine with one volume of oxygen to form two volumes of protoxide of nitrogen.

It is seen in these two cases that the three volumes of combining gas are reduced to two volumes by the act of combination. There is a condensation of one-third. In ammonia there is a condensation to half the original volume; on the contrary, in the case of binoxide of nitrogen and of hydrochloric acid equal volumes of the two gases combine without condensation. Thus:—

III. Three volumes of hydrogen are combined with one volume of nitrogen in two volumes of ammoniacal gas.

IV. One volume of nitrogen is united with one volume of oxygen in two volumes of binoxide of nitrogen.

V. One volume of hydrogen is united with one volume of chlorine in two volumes of hydrochloric acid gas.

The discovery of Gay-Lussac was of immense importance. In the first place it gave a striking confirmation to the law of definite proportions, which was thus demonstrated, not only in reference to weights, but also to volumes: and it must be remembered that an independent proof was by no means superfluous, for the law to which it referred had even at this period some opponents. Berthollet took great pains to demonstrate even in 1808 that the proportions according to which bodies combined are not absolutely invariable. But even his great authority was of no avail against the power of facts. The opposite theory was victoriously upheld by Proust.

But there is another consequence of the discovery of Gay-Lussac. If we can admit with Dalton that the definite proportions according to which bodies combine represent the weights of their atoms, and if we are to agree with Gay-Lussac that the volumes according to which gases unite bear to each other simple and invariable proportions, it is clear that the relative weights of these volumes—that is to say, their densities—ought to represent the relative weights of the atoms. Thus, the atomic weights of gases ought to be proportional to their densities (or should at least bear a simple proportion to them). It therefore follows that to find the relative atomic weights of simple gases it is sufficient to determine and compare their densities. This is an immediate consequence of Gay-Lussac's law, and it is important from two points of view—first, in giving a new means for the determination or control of atomic weights, and then in leading chemists to realise a distinction between the notion of atomic weights and of equivalents. Hitherto they had been confounded, but henceforth a similar confusion was not possible. This is an important point, and it must, therefore, be clearly explained.

We have seen that Dalton, taking the atomic weight of hydrogen as unity, adopted for that of oxygen the figure 7 (the exact figure is 8); and that he looked upon water as formed of one atom of hydrogen and one atom of oxygen. But as hydrogen combines with oxygen in the proportion of two volumes to one volume, if it is admitted that the atomic weights are in proportion to the densities, it must also be admitted that combination takes place in the proportion of two atoms to one atom. In fact, the densities of hydrogen and oxygen are in the ratio of 1 to 16, and not as 1 to 8, as would be required by Dalton's atomistic hypothesis of the composition of water. If, then, 1 is the atomic weight of hydrogen, that of oxygen will be 16; and since the combination of the two bodies takes place in the proportion of 1 to 8, or of 2 to 16, it evidently follows that water is composed of two atoms of hydrogen and one atom of oxygen. This is an inevitable consequence if we allow a proportionality between atomic weights and densities.

In respect to simple gases chemists have been led to admit this proportion, and to regard their volumes as representing atoms, and this conclusion has been strengthened by considerations drawn from the physical properties of gases. When examined at a moderate distance from their liquifying point, they dilate or compress in appreciably the same manner under the influence of the same variations of temperature and pressure.

It has therefore been admitted, Ampere being the first,[*] that equal volumes of two gases contain the same number of atoms, and that consequently the atomic weights of simple gases are proportional to their densities.

Thus, the discoveries of Gay-Lussac became one of the fundamental bases of the atomic theory. In regard to this, Berzelius wrote as follows[†]:—"If we say atom instead of volume, and if we view bodies in the solid state instead of taking them in the gaseous state, we find in Gay-Lussac's discovery one of the most direct arguments in favour of Dalton's hypothesis."

It is a remarkable fact, that this latter philosopher opposed in principle Gay-Lussac's ideas; this singular opposition may be explained if we remember that Dalton had stated that when two bodies form only one combination, this is effected atom by atom. The law of volumes upset this hypothesis, which, moreover, rested on no solid foundation. This law was soon admitted by all chemists; and among those who used it largely in the development of the atomic theory, Berzelius stands first.

(To be continued.)

New Process for Determining the Acetic Richness of Vinegar,[‡] *by M.* JAILLARD.

NUMEROUS processes have been proposed for determining the amount of real acetic acid in vinegar. They may be divided into physical and chemical processes. The first are founded on the use of acetimetres or vinegar weighers, but as vinegars contain variable quantities of water, acetic acid, salts, extractive matter, colouring matter, and sometimes even foreign substances added to them, it will be understood that instruments founded on the density of the vinegars may be liable to error.

The determination by weighing has been unsuccessfully attempted by several clever chemists, it requiring much care and much time. Volumetric methods, so simple and so easy, have been adopted by a great many authors; carbonate of potash has been employed by Soubeiran, ammonia by Ure, saccharate of lime by MM. Greville and Violette, carbonate of soda by M. Chevallier, and finally biborate of soda by M. Reveil. But all these pro-

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[*] The same idea was expressed by the Italian chemist, Avogadro.

[†] "Traité de Chimie," French edition, 1831, iv., p. 32.

[‡] "Memoires de Medicine et de Pharmacie Militaires."

cesses have been applied directly, without taking certain difficulties into account, especially the presence of organic matters, which prevent the acetic acid from giving clear reactions with alkalies indicating the moment of saturation. The characteristic tint was looked for in vain, and but very uncertain results were obtained. Instead of modifying the mode of operation, one base was replaced by another, but without any real advantage. The volumetric determination presents also a radical difficulty; it does not indicate the term of the saturation by an abrupt change of tint as is the case with other acidimetric assays.

M. Jaillard's process consists in indirect volumetric estimation, and requires no unusual instrument or reagent. A graduated burette, a pipette holding ten cubic centimetres, a beaker and a stirring rod, some tincture of litmus, a normal potassic solution of about one tenth, and a certain quantity of Gay-Lussac's normal sulphuric acid, are the only instruments and reagents required. The operation is divided into two parts, the determination of the standard of the alkaline solution and the determination of the standard of the vinegar.

Titration of the Alkaline Solution.—Introduce 10 cubic centimetres into the beaker, add 100 cubic centimetres of water, and 6 drops of tincture of litmus, then with the graduated burette ascertain the number of cubic centimetres of Gay-Lussac's liquid necessary to saturate them.

Acidity of Vinegar.—Place, as above, 20 cubic centimetres of the alkaline solution in the beaker, dilute them with 190 cubic centimetres of water, and colour with 6 drops of tincture of litmus; add 10 cubic centimetres of the vinegar to be assayed, a quantity insufficient to neutralise the potassic liquid, and with the graduated burette finish the saturation with Gay-Lussac's normal sulphuric acid. The reaction is perfect when a single drop of acid liquid suffices to alter the colour. If, to effect the saturation, only 12 cubic centimetres of normal acid have been required, the difference between the quantities of acid used in the two portions of the operation evidently gives the amount of acetic acid required.

This difference, 19·5 − 12 = 7·5, gives the amount, in weight, of monohydrated acetic acid in 100 parts of vinegar analysed by means of a simple proportion in which it is one of the given terms, and of which the others are represented by the equivalents of monohydrated sulphuric and acetic acids—

$$612{\cdot}50 : 750 :: 7{\cdot}5 : x \text{—} x = 9{\cdot}18 \text{ per cent.}$$

of monohydrated acetic acid.

This calculation may, moreover, be avoided by referring to the following table, in which is given the acetic richness of the vinegar facing the number of cube centimetres of normal acid, representing the differences found:—

	Acetic richness.		Acetic richness.
1	1·22	9	11·01
2	2·44	10	12·24
3	3·67	11	13·46
4	4·89	12	14·68
5	6·11	13	15·91
6	7·34	14	17·13
7	8·57	15	18·35
8	9·79		

The results given by this process are as exact as possible, provided it be previously ascertained that the vinegar contains no other acid except acetic acid. It does, however, contain tartaric, succinic acids, &c., but in proportions so small as to render it unnecessary, in practical assays, to correct the data of the analysis.

TECHNICAL CHEMISTRY.

The Purification of Sulphate of Zinc,*

by M. le Dr. Van den Corput.

The processes used in Germany for purifying sulphate of zinc differ from those used in Belgium and France. All, though varying in the *modus faciendi*, are founded on the peroxidation of the ferrous, manganous oxides, &c., &c.; and on the precipitation of these per-oxides by means of hydrated oxide or carbonate of zinc.

As most metallic oxides of the third group are displaced by oxide of zinc, only in their highest state of oxidation, we begin by peroxidising these bases by passing a current of chlorine into the diluted liquid, until the solution, after having been shaken, decolorises litmus paper; then, after having separately precipitated about $\frac{1}{10}$th of this solution by carbonate of soda or by a little caustic potash, we collect on a filter the precipitate of carbonate or oxide of zinc thus produced, and wash it to get rid of the sodic carbonate it invariably takes with it.

The gelatinous substance collected on a filter is mixed, cold, with the rest of the solution, and then boiled for a few minutes.

Gmelin has proposed a modification of this method; it consists in precipitating directly part of the solution by carbonate of soda, mixing the precipitate, after washing, with the rest of the liquid, and then passing the gaseous chlorine through the mixture, which must be shaken until the greater part of the basic carbonate of zinc is dissolved and the liquid has assumed an opaque brown colour, owing to the precipitation of ferric, manganic, cobaltic, and niccolic oxides in the state of hydrates. The liquid having been first shaken and then boiled, the foreign oxides are allowed to deposit themselves, then the clear liquids are decanted and filtered, which, necessarily containing basic sulphate of zinc, must be acidulated by a little sulphuric acid before being crystallised.

By evaporating this acid solution of sulphate of zinc to the point of crystallisation, a salt is obtained, by means of which may be prepared, by the wet way, a brilliantly white basic carbonate of zinc.

The sulphate of zinc obtained in this way is not perfectly pure, for in consequence of the introduction of chlorine, which, by contact with carbonate or hydrate of zinc, forms chloride of zinc, it is difficult entirely to free this salt from crystals of sulphate of zinc—at least, without taking the precaution of adding a little sulphuric acid to the mother liquors.

A diluted solution must be used for this operation, for, as Schindler has remarked, a concentrated solution of sulphate of zinc absorbs chlorine with great difficulty.

Death of Dr. Ulrich.—We are sorry to have to announce the death, after a short illness, of this promising chemist, who was well known and highly esteemed by a numerous circle of scientific friends in London.

Pulverisation of Phosphorus. — Blondlot has found that phosphorus may be reduced to a very fine powder by melting it in a hot concentrated solution of any neutral salt, or even of syrup, and shaking continually until cold. It has long been known that phosphorus was brought to a finer powder in urine than in water, and that effect was ascribed to the presence of urea. M. Blondlot shows that it is merely a consequence of the density of the liquid.

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* *Journal d'Anvers.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, February 16.

Professor A. W. Williamson, *Ph.D., F.R.S., President in the Chair.*

The Secretary read the minutes of the last ordinary meeting, which, by the special invitation of Dr. Hofmann, was held in the Lecture Theatre of the Royal College of Chemistry. The several donations to the library were announced, and the names of the following candidates read for the first and second times respectively, viz.:—Dr. William Johnson, F.R.S , Newcastle-upon-Tyne, and Mr. George Jones, 106, Leadenhall Street. The Secretary then read a resolution passed at the last meeting of the Council, having reference to the election of officers for the year ensuing; it was thus worded:—"Resolved,—That the following officers and other members of the Council be recommended for election at the ensuing anniversary meeting of the members of the Chemical Society, in accordance with the bye-laws:—*As President:* Dr. W. A. Miller, in place of Dr. Williamson, who retires. *As Vice-President:* Mr. Warren De la Rue, in place of Mr. Alfred Smee. *As Treasurer:* Dr. Theophilus Redwood, in place of Mr. W. De la Rue. *As Secretary:* Mr. Augustus Vernon Harcourt, in place of Dr. T. Redwood. *As non-resident Member of Council:* Mr. G. C. Foster, in place of Dr. Andrews. *As resident Members of Council:* Mr. Duppa, Mr. Hadow, Mr. G. B. Buckton, in place of Dr. Mattheissen, Mr. Nicholson, Mr. J. T. Way."

A paper was read by Mr. John Broughton, B.Sc., entitled "*On a New Reaction for the Production of Anhydrides and Ethers.*" The author commenced by reviewing the methods employed for the preparation of the anhydrides of the monobasic organic acids, describing particularly the processes of Gerhardt and of Gal, and mentioned an unsuccessful attempt to procure acetic and benzoic anhydrides by the action of boracic acid upon the potassium salts of these acids. It then occurred to him to try the effect of bisulphide of carbon, which Frémy had shown to be readily decomposed by heated metallic oxides, with formation of carbonic anhydride and a metallic sulphide, and at a high temperature even by water, with production of sulphuretted hydrogen and carbonic anhydride. It was therefore thought probable that by acting on the dry metallic salts of the organic acids with bisulphide of carbon, the metal would be converted into sulphide and the anhydride set free. This opinion has been completely confirmed by the result of experiment. The author succeeded in forming acetic anhydride by heating together in sealed glass tubes acetate of lead, perfectly dried and finely pulverised, with a sufficient quantity of the bisulphide of carbon to form a paste or mixture of creamy consistence. The temperature employed was about 160° C., and inasmuch as the chemical reaction gave rise to the liberation of large quantities of gas the author recommended that the tubes should be opened once daily to relieve the pressure, again sealed, and then returned to the oil bath. When the reaction was judged to be practically terminated the liquid contents of the tubes were poured off as close as possible, the remaining portion being separated by distillation from the black sulphide of lead, and the whole liquid product purified by the same means. After the excess of bisulphide of carbon, and small quantities of acetic acid and acetone had passed over the temperature rose gradually to 137° C., and the boiling point remained constant, when a pungent liquid of acid odour, attacking the eyes and nostrils, was collected, which proved to be acetic anhydride $C_4H_6O_3$. Its formation would be thus explained:

$$2\left[\left.\begin{matrix}C_2H_3O\\Pb''\\C_2H_3O\end{matrix}\right\}\begin{matrix}O\\O\end{matrix}\right]+CS_2=2PbS+CO_2+2\left[\left.\begin{matrix}C_2H_3O\\C_2H_3O\end{matrix}\right\}O\right]$$

The acetate of silver gave similar results with even greater facility. The author then proceeded to apply the principle of this reaction to the formation of compound ethers, and to the isolation of certain anhydrides of electro-positive radicals or ethers. In order to procure the acetate of phenyl, the corresponding lead salt was sealed up in tubes with an equivalent quantity (or better only half an equivalent) of phenylic alcohol, and a considerable excess of bisulphide of carbon. The tubes were then heated in an oil bath to the temperature of about 170° C., when the expected reaction soon commenced, and proceeded with great ease and regularity, on account of the solubility of the lead salt in the phenylic alcohol. The pressure of gas accumulating as before, rendered it necessary to open the tubes repeatedly, and when eventually the escape of gas had nearly ceased, the liquid contents were separated and submitted to distillation. The products which came over first were the excess of bisulphide of carbon employed, and acetic acid, with a small proportion of acetic anhydride; when the temperature rose to 190° C., a liquid of pleasant empyreumatic odour made its appearance, which proved to be the substance in question. The acetate of phenyl, after rectification, had a constant boiling point of 200° C., and vapour density equal to 4·72 – a number not widely different from 4·59 demanded by theory. Its properties were thus described:—A colourless, fragrant, liquid becoming somewhat yellow by keeping, of specific gravity 1·074, neutral to test-papers. It is slightly soluble in water, to which it imparts its peculiar odour; boiling alkaline solutions dissolve it with production of mixed acetate and phenate. Its index of refraction appears to be identical with that of German fusible glass (a fact demonstrated at the meeting by the exhibition of a small sample bottle of the ether, in which were immersed short lengths of glass rod, that became almost invisible, even upon close inspection). The author suggests the application of the same process as a mode of forming ethers of the phenylic series, of which the preparation has hitherto presented difficulties; and, lastly, refers to experiments upon which he is at present engaged, whereby he hopes to eliminate phenylic ether from phenate of lead. The author concludes by pointing out the possible application of this process as a means of procuring a variety of double ethers and anhydrides, and mentions several reactions with other metallic salts which have been as yet but partially examined.

In proposing a vote of thanks, the President remarked upon the great interest attaching to Mr. Broughton's communication, and recommended a study of the intermediate steps in the reaction first described.

The next paper was read by Mr. J. Spiller, and entitled "*On the Oxidation of India-Rubber.*" The author commenced by referring to the earlier researches of Dr. A. W. Hofmann, who communicated to the Chemical Society four years ago a statement of the changes which *gutta-percha* is found to undergo by free exposure to air, and especially under the influence of a hot climate; and it was then proved that the deterioration in quality of the insulating coating of the Indian telegraph wires was the result of a gradual oxidation of the natural gum.* The author then proceeded to describe an interesting example of the gradual alteration of india-rubber, which was presented by an article of commerce known under the name of "Patent Waterproof Felt." This material serves the purpose of a cheap packing, and is used in the exportation of silk and other valuable fabrics, stationery goods, and many articles which are liable to be affected by damp; it is sold in sheets of great length and about a yard wide, and appears to be made by cementing or matting together the fibres of cotton wool through the intervention of india-rubber paste or solution, so that after the evaporation of the coal-naphtha or other solvent, and passing

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* *Quarterly Journal of the Chemical Society*, vol. xiii., p. 87.

through rollers, a continuous and water-repellent fabric is produced. About six years ago, Mr. Spiller purchased some of the waterproof felt, and made some useful applications of it in the way of photography; some of the material had, however, been laid aside until recently, when, upon examination, it proved to possess no longer the strength, close structure, and waterproof qualities of the original article. Finding this to be the case, the properties of the aged material were compared with a sample of recent manufacture, and the altered fabric examined in the same manner that it had been tested six years ago—viz., by extracting the rubber with benzol, and noting the character of the film left upon the evaporation of the solvent. When thus treated the original fabric furnished a beautifully white cotton flock, and a solution which, being evaporated, left a perfectly elastic film of pure india-rubber; and the same results were obtained upon the examination of the newly manufactured sample; but, on the other hand, the altered fabric when treated with warm benzol gave a discoloured cotton and a solution which left upon evaporation a resin, or brownish-yellow brittle substance closely resembling shellac. The chief examination of this interesting product was made upon the material extracted from the fabric by warm alcohol, which left insoluble, besides the cotton, a small quantity of unchanged rubber easily separated by filtration; and the amount of the brittle resin procured in this manner from a square foot of the fabric weighed, after complete evaporation of the solvent over a water bath, 74 grains. A considerable quantity of this altered india-rubber was thus prepared, and its chief properties were the following:—It is freely soluble in alcohol, especially if warmed, in wood spirit, chloroform, and in benzol as already stated. It is not appreciably soluble in ether, bisulphide of carbon, or oil of turpentine. Alkalies dissolve it with ease, and it may be reprecipitated from such solutions by neutralising with acids. Like india-rubber itself, it becomes bleached upon immersion in aqueous ammonia. The resin fuses below the temperature of boiling water, and when strongly heated in a retort gives off an amber-coloured oil of agreeable empyreumatic odour, besides furnishing water,—a proof of its containing oxygen. At ordinary temperatures it is extremely brittle and highly electric, so much that it cannot be powdered in an open mortar without loss. When rubbed with silk the substance exhibits the phenomena of "resinous electricity." An analysis of the resin was made by combustion with oxide of copper which indicated the following percentages:—

Carbon	64·00*
Hydrogen	8·46
Oxygen	27·54

For the reasons adduced by Dr. Hofmann in the case of the altered gutta-percha examined by him, Mr. Spiller abstained from constructing a formula, merely regarding this substance as an oxidation product formed directly from caoutchouc by the absorption of atmospheric oxygen in much the same manner that resins are formed from essential oils and other hydrocarbons.

Dr. **Warren De La Rue** stated that he once had an opportunity of inspecting the manufacture of the waterproof felt at Manchester, and the mode of procedure was substantially as described by Mr. Spiller. The india-rubber softened by benzol or some other solvent, to the condition of a thick dough, was applied to the cotton fibres by means of rollers. The ordinary material did not contain sulphur, but he had in his possession samples prepared eighteen years ago which were vulcanised by admixture of sulphur and subsequent heating, and they had remained throughout this long period of time in their original condition.

Professor **Abel** said that nine years ago he had occasion to examine some of the india-rubber goods which were returned from the Crimea, and found in several instances a kind of resin, very similar to shellac, which at the time he believed to be evidence of sophistication. This was detected only in the unvulcanised materials, and there could be little doubt, after the discoveries of Dr. Hofmann and Mr. Spiller, that the deterioration observed was attributable to the action of oxygen upon the india-rubber, promoted by the state of porosity consequent upon the large quantities of mineral matter which he found to be present in the waterproof material.

Mr. **Spiller** further stated that he had succeeded in preparing combinations or mixtures of caoutchouc with the resin just now described, by impregnating sheets of india-rubber with solutions of the oxidised substance, and then allowing the solvent to evaporate. Such compounds were inferior to pure rubber in the qualities of softness and elasticity. With regard to the resin itself, the physical properties and the analytical results seemed to indicate that gutta-percha and india-rubber both furnish the same ultimate product by the absorption of oxygen.

Dr. **Odling** suggested that the colour of the resin might be accidental, and that possibly white gutta-percha, as prepared by precipitation from its solutions by alcohol, might furnish a white resin. Like shellac itself, the resin might, perhaps, exist in two states—white and coloured.

Mr. **Henry Bassett** then communicated a "*Note on the Action of Chloropicrin and Chloroform on Acetate of Potash.*" When chloropicrin is heated with fused acetate of potash and alcohol to 100° C. in a closed vessel, the first-named substance is decomposed with great readiness, forming an abundance of chloride of potassium without disengagement of gas. The author obtained the best results when he employed nine equivalents of the acetate to one of chloropicrin, which gave rise to the production of acetic ether and binacetate of potash, besides carbonate, nitrite, and chloride of potassium, according to the following equation:—

$$CNO_2Cl_3 + 9C_2H_3KO_2 + 3C_2H_6O = 3KCl + KNO_2 + K_2CO_3, \\ + \underset{\text{Acetic ether.}}{3C_4H_8O_2} + \underset{\text{Binacet. of potash.}}{3C_4H_7KO_4}.$$

The author remarked that the last-named product was not nearly so deliquescent as the ordinary acetate of potash, and that it rotated violently on the surface of water. Chloroform treated in a similar manner did not suffer any appreciable decomposition at the temperature of 100° C., but when the heat was raised to 125° C. the chloride of potassium was quickly formed. Upon opening the tubes a small quantity of carbonic oxide escaped, and formiate of potash, besides acetic ether and binacetate of potash, were generated, the reaction being similar to the previous example:—

$$CHCl_3 + 6C_2H_3KO_2 + 3C_2H_6O = \\ 3KCl + CHKO_2 + 2C_4H_8O_2 + 2C_4H_7KO_4.$$

The author concludes by describing the action of aniline upon chloropicrin, which at the temperature of 145° is somewhat violent, much nitrogen being evolved. On digesting the product with boiling water, a red colouring matter is dissolved out, which appears to be similar to that obtained by Dr. Hofmann as the result of the action of tetra-chloride of carbon upon aniline. The solution also contains the hydrochlorate of a solid base, the platinum salt of which was analysed with results closely agreeing with that of carbo-triphenyl-triamine. Mr. Bassett is now engaged in studying the action of cyanide of potassium upon chloropicrin.

In answer to the President, Mr. **Bassett** stated that in the absence of alcohol the chloroform remained unacted upon.

The following paper was then read by the **Secretary**,

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* In writing these numbers upon the board Mr. Spiller placed in comparison with them the figures representing one of Dr. Hofmann's compounds from gutta percha, viz.:—

Carbon	62·79
Hydrogen	9·29
Oxygen	27·92

viz., "*On a Dense Brine from Saltsprings, Nova Scotia,*" by Professor How, D.C.L., University of King's College, Windsor, N.S. The sample of water analysed was remarkable for containing unusually large quantities both of common salt and sulphate of lime, and formerly served for the commercial preparation of the first-named substance. Boracic acid and bromine were detected among the soluble constituents of the water. Its specific gravity at 53° F. was 1046. The analytical results, stated in accordance with the plan of Fresenius, stand thus:—

	Grains per gallon.
Chloride of sodium	4133·50
Chloride of calcium	51·91
Chloride of magnesium	27·33
Sulphate of lime	154·73
Carbonate of lime	3·77
Carbonate of magnesia	2·93
Carbonate of iron	·18
Silica	·56
Total	4374·91

The brine in question contains, then, nearly twice as much salt as sea water, and is nearly on a par with the strongest saline water of Canada, which contains 4762 grains of dissolved constituents in a gallon. The remaining portion of the author's paper is devoted to a comparison of the leading constituents of this water, with the amounts contained in a variety of other samples from all parts of the world. And, secondly, treats of the degrees of solubility of the carbonates of lime and magnesia in water alone, and when associated with other mineral salts.

The President remarked that the directions given by Dr. Fresenius had usually been followed in stating the results of water analysis; but it was not always correct to say that the strongest acids were united with the strongest bases. In seeking for the true method, one encountered the difficulty of placing every acid in part combination with every base. Such a measure would be practically impossible, although he believed it to be founded upon truth.

Dr. Odling reminded the Society that the point raised by Dr. How with respect to the solubility of magnesia compounds had already been answered by Mr. Warington, jun., in his recent communication. The speaker remembered the publication of a certain analysis of Thames water collected at Greenwich, according to which there were sulphate of soda and chloride of calcium among the saline constituents, but not a trace of common salt!

Mr. Newlands asserted the fact of precipitated phosphate of lime being appreciably soluble in an aqueous solution of chloride of ammonium—a circumstance which stood in the way of the correct determination of this constituent in manures, &c., by simple precipitation with ammonia.

The President stated an observation to the effect that the calcic oxalate was practically insoluble in dilute acetic acid, but no longer remained so in the presence of certain mineral salts.

The meeting was then adjourned until March 2, when Dr. Crace Calvert would read a paper "*On the Action of Silicate and Carbonate of Soda on Cotton Fibre;*" and Professor C. L. Bloxam had promised a communication "*On the Action of Chlorine upon Arsenic Acid.*"

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, February 7, 1865.

R. Angus Smith, *Ph.D., F.R.S., &c., President, in the Chair.*

Among the donations announced was a framed photographic portrait of the late Thomas Hopkins, Esq., formerly a Vice-President of the Society, presented by James Mooney, Esq.

On the motion of Dr. Joule, seconded by Mr. Robert Worthington, the thanks of the Society were unanimously voted to Mr. Mooney for his valuable donation.

The President drew attention to the late fatal explosion at Peterborough, and asked whether the easy method of testing steam boilers, described some years ago by Dr. Joule, was forgotten or found to be impracticable?

Dr. Joule said that he had taken pains to give his method, by which the testing by hydraulic pressure could be applied with the utmost facility by simply filling the boiler with water and then raising its temperature a few degrees, a very extended publication. He believed that the objection raised by some to its use was the absurd one that hydraulic pressure injured the boiler. The very object of a test was to detect weak boilers for the purpose of strengthening or rejecting them. He was at a loss for terms strong enough to express his opinion of the reckless disregard of life, or the ignorance which resulted in the deplorable catastrophes which were constantly occurring: and he believed that the only method of cure would be that proposed by Mr. Binney in the case of the explosion of firedamp in mines—namely, that the parties to blame should be compelled to support the widows and orphans of their victims.

Mr. Alderman Pochin stated that he had made use of Dr. Joule's plan, and found it quite practicable and easy of application.

A paper was read "*On a New Reagent for the Separation of Calcium from Magnesium,*" by Edward Sonstadt, Esq., which we shall publish next week.

ACADEMY OF SCIENCES.

February 13, 1865.

In a paper on "*New Thermo-electric Piles formed of Metallic Sulphides,*" M. E. Becquerel recalls that so early as 1827 his father had remarked that a copper wire covered with sulphur was strongly positive in relation to ordinary copper, and upon this observation had constructed a pile of two copper wires, one covered with sulphur, and the other not, which, at from 200° to 300°, developed a force capable of effecting some electro-chemical decompositions. He proceeded to point out that sulphur profoundly modifies the electric properties of all metals, rendering the positive more positive and the negative more negative. A mixture of sulphur and bismuth, which can easily be melted together, for example, is strongly negative to bismuth itself; and a couple formed of sulphured bismuth and copper gives three times the electric force of the ordinary bismuth-copper couple. Protosulphide of copper, under certain molecular conditions, is eminently positive in relation to other mineral and metallic substances; and the author has accordingly constructed a pile composed of ten cylindrical bars of this substance, ten centimetres long, and one centimetre in diameter, with copper wire rolled round each extremity; and with this battery raised to 300° or 400°, he is enabled to decompose a solution of sulphate of copper, and work a telegraph. The author is still engaged in the construction and study of these piles, and now calls attention to the matter in consequence of Bunsen's announcement of his discovery of the thermo-electric properties of pyrites and pyrolusite.

M. H. St. Claire Deville publishes an account of further experiments "*On the Dissociation of Carbonic Oxide, Sulphurous, Chlorhydric, and Carbonic Acids, and the Decomposition of Ammonia.*" We have published at page 2 of this volume an account of the apparatus which the author has devised to demonstrate the facts of dissociation, and all we need say here is that for his experiment with sulphurous acid the inner metallic tube which carries the stream of cold was silvered on its external surface. After the current of sulphurous acid had continued for some hours, the silver surface was found to be blackened or sulphuretted, and at the same time covered with a layer of anhydrous sulphuric acid, showing that sulphurous acid had been dissociated or incompletely decomposed into sulphur, which was deposited on the silver, and oxygen, which combined with the excess of the acid to form sulphuric acid. Until now sulphurous acid has been considered completely undecomposable by heat. The author then shows how the same effect may be shown with the induction spark. To this description we shall return.

In the experiment with hydrochloric acid, the author amalgamated the silvered surface of the cold tube with a very small amount of mercury, and so obtained a very brilliant surface. After pure hydrochloric acid gas had passed for some hours, this surface was found covered with chloride, and by a peculiar arrangement the author was able to collect some hydrogen.

The experiments with carbonic oxide confirm the results detailed in the author's former paper, to which we have alluded above.

Carbonic acid has only been experimented upon with the induction spark. The author now shows that by placing a ball of phosphorus on the surface of the mercury in the eudiometer tube, and continuing the spark for some days, the carbonic acid will be completely dissociated, and only the same bulk of carbonic oxide found in the tube.

As regards ammonia, the author shows that the decomposition of this gas by the induction spark is never complete. It is true that when the volume of the gas has been doubled no absorption appears to take place when water is poured into the eudiometer tube. But if some hydrochloric acid gas be passed in, the presence of undecomposed ammonia is made manifest at once. This paper is of great interest, and we shall return to it on an early occasion.

An interesting report was read on the memoir of MM. Tresca and Laboulaye, entitled, "*Experimental Researches on the Mechanical Theory of Heat*," to which we can only direct the attention of our readers. The reporters, while accepting the author's determination of the mechanical value of an unit of heat, pay a high compliment to Mr. Joule, who was, they say, undoubtedly the first to assign an approximate value.

M. Tellier, in a note, suggested *an application of ammoniacal gas*, which is ingeniously adapted to the needs of some Parisian houses. Some account of the application is given in our Paris letter.

M. Cailletet communicated some "*Analyses of the Gases Produced in the Cementation of Iron.*" The cementation was effected in a close iron box of his own contrivance, and the gas withdrawn by means of an expirator. We give the composition of the gas withdrawn at intervals:—

	After 8 hours.	After 32 hours.	After 60 hours.
Hydrogen . .	26·60	39·80	37·76
Carbonic oxide .	15·55	15·30	16·32
Carbonic acid .	20·06	00·00	00·00
Nitrogen . .	37·79	44·90	45·92
	100·00	100·00	100·00

The gases were washed as they came from the box, but no trace of cyanides was found in the water.

M. Friedel presented a note "*On the Action of Bromine on Isopropylic Alcohol and on Iodide of Isopropyle.*" Bromine first removes $2H$ from isopropylic alcohol, transforming it into acetone, which seizes upon other portions of bromine to form substitution products; and hydrobromic acid set free converts a part into bromide of isopropyle. This action is analogous to that which takes place with bromine and vinic alcohol. The action of bromine on iodide of isopropyle differs from that which is exerted on iodide of ethyl, and thus isopropylic alcohol, and probably the other alcohols derived from acetones, are found to occupy a place intermediate between true alcohols and the pseudo-alcohols of Wurtz. They resemble the former in their behaviour towards bromine, and the second in their property of giving by oxidation aldehydes not susceptible of being transformed into acids (acetones).

M. Verstraet communicated "*A New Method of Estimating Sulphides by Means of Ammoniacal Nitrate of Copper.*" This we shall transfer to our pages.

MM. Moutier and Dietzenbacher presented a note "*On a Property of Sulphur.*" The second of these gentlemen showed some time ago that sulphur melted with a small proportion of iodine retained its plastic state. The authors now show that a number of other substances,—naphthaline, paraffin, camphor, oil, wax, &c., confer the same property. The mixture with some of these substances is insoluble in sulphide of carbon. Carbon also greatly modifies the properties of sulphur, rendering it completely fluid at 270°.

NOTICES OF BOOKS.

On Food as a Means of Prevention of Disease. By Erasmus Wilson, F.R.S. London: Churchill and Sons. 1865.

Although there is little to be said about progress in the art of curing diseases, much might be written on the advance made in our knowledge of the means of preventing them. Hygiene is far in advance of therapeutics. It is no great wonder that it should be so; for a little observation and some common sense are all that is required to develope the laws of the one, while varied knowledge, deep thought, patient experiment, and rigid induction must be exercised before any real advance can be marked in the other.

Amongst the means of preventing disease a sufficiency of wholesome food is unquestionably the most important. The morbific effects of foul air and impure water are transient compared with the results of underfeeding, and, moreover, may be often resisted with a sufficiency of food. Cholera and fever (the constant companion of famine) kill their victims or leave them much as they were before; but improper food, or an insufficiency of food, produces other disorders of body and of mind, which transmit their evil influences from generation to generation.

With the richer classes the remedy is in their own hands. As regards the poor, the philanthropists and the economists must bestir themselves, if it be true, as Mr. Wilson tells us, that three meat meals a-day are necessary to keep man, woman, and child in sound health.

Most of Mr. Wilson's little book is devoted to remarks on the dietary of infancy and childhood, and on that account it should be read by every parent who is anxious to secure the health of his offspring. What, however, with the caprices of children's appetites and exigencies of various sorts, probably few readers will be able to carry out the suggestions. Children, he says, are almost universally underfed, and the majority of the diseases of childhood arise from the debility of constitution induced by this habit of underfeeding. The preventive measure is three meals a-day, consisting of one-third vegetable and two-thirds animal food. We shall not stop now to point out—for we shall no doubt have shortly to notice another little book by some medical man pointing out—the many evils which may result from an excess of animal diet, and, moreover, it is beyond our business to concern ourselves minutely with these matters.

Mr. Wilson is a "specialist," and all his illustrations of the effects of improper food are borrowed from his own practice in skin diseases. But he can see beyond the skin, and we quote the closing paragraph of his book with much satisfaction, as embodying the opinion of a sensible, observant, well-informed medical practitioner:—

"I must not be supposed to undervalue light and air, and cleanliness and exercise, the kindred of food; but if it were my commission to improve the human race, to produce finer, stronger, and better men, to extinguish disease, I should begin with food; and if it were my duty to lay down rules for the prevention of disease, I should, in the first instance, endeavour to secure the co-operation and influence of man's first and best friend—his stomach."

Bulletin de la Société Chimique de Paris, &c. January, 1864.

We notice here a decree of the Emperor recognising the Chemical Society of Paris as an institution of public utility, and approving the statutes of the Society, no alteration in which can now be made without the sanction of the Emperor.

Among the proceedings of the Society we have the papers of M. Deville "*On the Dissociation of Carbonic Oxide,*" and "*On the Constitution of Sal-ammoniac and on Vapour Densities.*" Appended to the latter is a note by MM. Deville and Pebal "*On the Action which the Vapours of Sal-ammoniac and Hydrochloric Acid exert on Mercury.*" Dissociation the authors define as the partial separation of the elements, below the point of total decomposition, and they endeavoured to determine the tension of the hydrochloric acid and ammonia in the salt not decomposed. They placed a little sal-ammoniac and a few grammes of mercury in an ordinary vapour density balloon, and arranged the drawn out end so as to collect any gas if evolved. The balloon was then placed in a bath of boiling mercury vapour, and kept there for two hours. No gas was produced, but some absorption evidently took place, as if some gas had disappeared, which was probably oxygen from some air unavoidably present. After cooling the sal-ammoniac in the balloon was dissolved in water, and only a trace of chloride of mercury was discovered, corresponding probably to the small amount of air present.

Taking into consideration the alterability of mercury in the presence of hydrochloric acid, the authors conclude that the tension of dissociation of sal-ammoniac in its own vapour is very low. In another experiment they kept vapour of mercury in a continuous current of pure dry hydrochloric acid gas. In this experiment the amount of chloride of mercury found was less than in the other, and no hydrogen was collected. In this case the authors suppose the chloride to have been formed in consequence of a small amount of oxygen present with the hydrochloric acid. The experiment proved that pure hydrochloric acid and mercury exerted no influence on one another at 360°, but led to no conclusion as regards the tension of the dissociation of sal-ammoniac at that temperature.

Most of the other papers in the proceedings have already been noticed by us, but we find one "*On the Chemical Constitution of 'Vert de Guignet,'*" by M. Scheurer Kestner, which we have not seen before. Our readers will remember the analyses of this substance by Mr. Shipton, given from Dr. Hofmann's Exhibition Report at page 275, vol. viii., Chemical News. Mr. Shipton regarded the compound as borate of hydrated oxide of chromium. M. Kestner considers the boracic acid as an accidental ingredient, and believes the colour to be essentially hydrated oxide of chromium, which obstinately retains some boracic acid. The colour, we may say, is formed by fusing together boracic acid and bichromate of potash, and then well washing the mixture, which leaves behind the green substance in question. The reaction which actually takes place in the fusion, and the exact constitution of the colour, may still be regarded as doubtful.

Chemical Society.—The next meeting of this Society will be held on Thursday, March 2, at 8 o'clock, when the following papers will be read:—"Action of Silicate and Carbonate of Soda on Cotton Fibre," by Mr. Crace Calvert; "Bihydrate of Oxide of Phenyl," by Mr. Crace Calvert; "Action of Chlorine on Arsenious Acid," by Professor Bloxam; "A New Cornish Mineral," by Mr. Church.

NOTICES OF PATENTS.

1406. *Apparatus for obtaining Extracts from Tea, Coffee, &c.* E. Loysel, Clapham. Dated June 6, 1864. (Not proceeded with.)

This specification describes an improved construction of Loysel's apparatus, in which the process of filtration of the tea or coffee extract is conducted by the pressure of the atmosphere.

1409. *Dyeing and Printing.* E. J. Hughes, Manchester. A communication. Dated June 7, 1864.

The patentee claims the production of a black dye on cotton or linen cloth or yarns by the use of a salt of aniline, in conjunction with chlorate and chromate of potash, and the sulphides of copper or iron. This method of proceeding is very similar to that described by Mr. Lightfoot, and appears to be identical with that of M. Lauth, given at page 65 of our present volume.

1418. *Separation of Animal Substances from Rags of Mixed Fabrics.* A. T. Weld, Gravesend, and J. F. Powell, Albion Place, Hyde Park. Dated June 7, 1864. (Not proceeded with.)

The main features of this invention coincide with those of the earlier patent of Mr. F. O. Ward and Captain Wynants, which was rewarded by the bestowal of a prize medal at the International Exhibition of 1862. For a full account of this ingenious process the reader is referred to pages 149 and 150 of Dr. Hofmann's Report.

1468. *Sheathing Ships.* J. Brown, Aldgate, J. T. Way, and T. M. Evans, Leadenhall Street, London. Dated June 14, 1864.

Instead of employing marine glue for the attachment of glass or vitreous-coated plates to the bottoms and sides of ships, the inventors propose to make use of a kind of glue already described in a former patent (No. 2629, of the year 1863), and to employ in conjunction with it canvas or other textile fabric coated on both sides with the glue in question, and upon this surface the warmed glass or vitreous plates are laid. When used upon the coatings of iron ships, it is preferred to apply heat to the metal itself prior to spreading the glue or coated fabric, and either to warm the exterior surface of the glue or the glass plates themselves to secure their firm attachment.

1483. *Cultivating Land in order to Increase the Productive Power thereof.* A. Ellissen, London. Dated June 15, 1864. (Not proceeded with.)

The inventor proposes to sink into the earth a number of zinc and copper plates in alternate series, and to make connection between them by wires or other suitable conductors, so that a galvanic action may be excited, and circulate through the contiguous earth, and the fertilising power of the land become in consequence vastly augmented!

1486. *Preserving Iron Ships and Ships' Sheathing from Corrosion and Fouling.* R. Whiteside, North Egremont, Cheshire. Dated June 15, 1864.

This invention is said to be an improvement upon the system of protecting the copper sheathing of ships by the adaptation of zinc plates. The patentee purposely avoids the constant metallic connection of the two metals by interposing a layer of gutta-percha or other non-conducting material, and, whilst thus insulating the zinc from the copper, provides the means of connecting them at will by wires brought on board the ship. It is recommended to couple the wires occasionally for the purpose of preventing the corrosion of the copper sheathing, and to disconnect at intervals, when the fouling or marine accumulations will be cleared off. For the protection of ships built or cased with iron, the inventor proposes to use two supplementary metals, with suitable wire connections, led on board the vessel, and by employing one metal which is positive, and another which is negative, to iron, the electric condition of the sheathing may be entirely under control, and both fouling and corrosion obviated in the manner already indicated.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

282. G. J. Vertue, Weymouth, Dorsetshire, "Improvements in the manufacture of oil cake and food for animals."

284. J. Moysey, Leytonstone, Essex, "Improvements in coating the bottoms and sides of ships and other submerged structures to prevent fouling and decay."—Petition recorded Feb. 1, 1865.

42. J. Lebandy, Paris, France, "A new system of boiling grain sugar in vacuo."—Jan. 6, 1865.

59. W. Baker, Sheffield, Yorkshire, "Improvements in the manufacture and refining of iron and steel."—Jan. 7, 1865.

127. J. Young, Limefield, Mid Lothian, N.B., "Improvements in producing gases and vapour in a heated state."—Jan. 14, 1865.

160. M. B. Mason, New York, U.S.A., "Improved method of purifying and oxidising metallic ores."

168. T. Labroussee, Prussia Street, and J. Keily, Grangegorman, Dublin, "Improvements in dyeing leather."—Jan. 19, 1865.

221. G. Haseltine, Southampton Buildings, Middlesex, "A new process of manufacturing syrup and sugar from maize and other cereal grains."—A communication from F. W. Goessling, Buffalo, N. Y., U.S.A.—Jan. 26, 1865.

263. J. A. Laurent and J. Casthelag, Paris, France, "Improvements in the manufacture of benzoic acid."—Jan 30, 1865.

Notices to Proceed.

2465. P. A. le Comte de Fontaine Moreau, Rue de la Fidélité, Paris, France, "Certain improvements in photography for obtaining images direct on cloth and other materials." A communication from J. N. Truchelut, Paris, France.—Petition recorded Oct. 6, 1864.

2484. J. G. Beckton, Whitby, Yorkshire, "Improvements in heating retort and other ovens for the distillation of shale, coal, and other substances."—Oct. 10, 1864.

2503. J. W. Nottingham, Kennington Road, Surrey, "An improved composition for lighting fires."—Oct. 11, 1864.

2511. J. Möller, Shaftesbury Villas, Hornsey Rise, Middlesex, "Improvements in the preparation or manufacture of colouring matter for marking ink, and other purposes."—Oct. 12, 1864.

2526. R. A. Brooman, Fleet Street, London, "Improvements in the manufacture of prussiates of ammonia, and the application of prussiates of ammonia to dyeing, printing, and to photography." A communication from A. Baudesson and P. Houzeau, Reims, France.—Oct. 13, 1864.

2559. A. Hill, Birmingham, Warwickshire, "Improvements in privies, dry closets, and commodes, and in deodorising substances, to be used in privies, dry closets, and commodes."—Oct. 17, 1864.

2966. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the mode of, and apparatus for, stopping bottles."—A communication from H. B. Goodyear, New Haven, Conn., U.S.A.—Nov. 28, 1864.

207. G. Haseltine, Southampton Buildings, Middlesex, "Improvements in the mode of, and means for, preserving fruit and other eatables."—A communication from B. M. Nyce, Indianapolis, Indiana, U.S.A.—Jan. 24, 1865.

219. J. G. Willans, St. Stephen's Crescent, Bayswater, Middlesex, "Improvements in the manufacture of iron and steel."—Jan. 26, 1865.

244. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the treatment of oils obtained from the distillation of tar, and in the application of the same to the purposes for which ordinary drying oils are applicable."—A communication from C. and V. Cordier, Paris, France.—Jan. 27, 1865.

CORRESPONDENCE.

Continental Science.

Paris, February 22.

Among the facts which will most interest your readers I may mention the completion of the "Dictionary of Pure and Applied Chemistry," by Liebig, Wöhler, and Poggendorff. This work was commenced in 1837, and the last part of the final volume has just been issued. In the meantime a second edition of some of the earlier volumes has been published. I know of no chemical work which has taken the same time to complete. Gmelin's "Handbook" was began by the Cavendish Society in 1847 or 1848, I think, and so has been a tolerably long time in hand; but at present there is a difference of ten years in favour of the Society. One would think that the time for large chemical dictionaries and cyclopædias had either passed or had not yet arrived.

M. Bergeron has published a paper on the manufacture and use of aniline colours considered from a hygienic point of view. He has observed that the vapours of benzole and acetic acid produce no ill effects on workmen, but that those of hyponitric acid do produce disorders of the respiratory organs. The vapours of nitrobenzole and of aniline cause various functional disturbances of the stomach and nervous centres, some of which seem to disappear after the workmen get accustomed to the vapours, but which sometimes produce more serious effects—fainting, delirium, coma, and convulsions. He remarks also a general anæmic condition among the workmen.

While on the subject of health I will just extract some numbers which show the general extension of the duration of life in France during the present century. In 1806—9 the average duration of life was—in males, 30 years, 6 months; in females, 32 years, 7 months; mean, 31 years, 6 months. Now, in 1865, it is calculated that males on the average live 33 years, 4 months; and females, 36 years, 4 months; mean, 34 years, 10 months. This extension is remarkable, taking into consideration the fact that for many years the number of the population has been almost stationary, or, at all events, has increased in a much smaller ratio than that of Great Britain, notwithstanding the enormous emigration which has gone on from the latter.

I cannot resist here copying the announcement of a very sensible disposition of property which has just been made by a Madame Pailloux. It may serve as a hint to some charitable or, possibly, vain person who may be thinking about leaving a large sum of money to some overgrown hospital in London. The benevolent lady in question has left a good country house and 1000 francs a-year for a doctor to attend gratuitously the poor of the commune in which she lived, either at their own houses or at an asylum, which she has also endowed for aged and necessitous agriculturists. Considering the remuneration Poor-law doctors receive in England, and that large hospitals are almost certain to become in time nests of erysipelas and pyæmia, and so kill rather than cure people, the will of Madame Pailloux is one which might be advantageously imitated in England.

It is rather early to speculate on the matter, but the last number of the *Journal of Practical Agriculture* reports that at present the prospects of this year's corn harvest in France are very satisfactory.

M. Menard has introduced some improvements in the method of fermenting grape juice. He has remarked that the exposure of such a large surface in the vats causes a considerable loss of alcohol by evaporation and also much of the bouquet. He therefore proposes to ferment in a closely covered vessel, and to carry the evolved gases and the volatile matters through a cooled washing apparatus, which detains these last. The wines fermented in this way he finds to possess a much superior flavour, and also 1 per cent. more alcohol.

The volatile products of fermentation have not, that I remember, been much studied. An old man who had worked in a London brewery I remember once told me that his master (who was certainly a scientific brewer) fermented beer under much the same conditions that M. Menard fermented his wine, and condensed a small quantity of liquid, two or three drops of which would quickly kill a strong cat. Do you know any record of any such experiments?

At Rivières they make tiles and bricks of a sandy clay which contains 32 per cent. of chalk. When first burnt they are so tender that unless they are carefully handled they fall to pieces. As soon, however, as they are cold enough to touch they are quickly removed from the furnace and carefully stacked. They are then soused with water, by the action of which they are so hardened that they may be used the next day for building. This fact is, perhaps, easily capable of a chemical explanation, and brickmakers may be able to gather a hint from it.

M. Tellier has found in the ready solubility of ammoniacal gas an easy means of producing a vacuum, and he has made an ingenious application of the fact. You are aware that present arrangements in Paris necessitate the occasional emptying of closets, to which arrangements, indeed, you may one day return in London. As at present conducted here, this is not an easy or savoury operation, but by M. Tellier's plan the difficulties and *desagréments* are removed at once. He fills a close iron box with ammoniacal gas, and transports it to the *vidange* to be emptied. A little water is allowed to enter the box, and a vacuum is created, and now a pipe from the box being plunged into the cesspool, the contents are forced up into the box, which can be carried away without the least offence.

Sericulture is rapidly recovering here. M. Renard has lately distributed 800 ounces of healthy eggs from Yokohama to the silk-cultivating districts in France to assist in replacing the stock destroyed by disease.

On Cotton Seed Oil.

To the Editor of the Chemical News.

Sir,—When, in the first number of your valuable paper for the current year, I gave a short abstract of some experiments on cotton seed and cotton seed oil some of my experiments were not sufficiently far advanced to be ready for the press. I have now the pleasure to communicate some further details.

The crude oil is eminently adapted for soap making: it can be made to yield both soft and hard soap and also lead soap (lead plaster). One hundred parts of the crude oil gave on experimenting on a small scale—viz., with a quantity of *one* imperial pint, weighing 8138·36 grains, 291·63 parts per cent. of soft soap, which at the time it was made, in November, 1864, contained 52·3 per cent. of water, but since it has constantly become more fluid, and when now a short time ago I estimated the proportion of water again I found its percentage increased to 65·74 per cent. The yield of soap with soda is at the rate of 169·33 parts for every 100 parts of oil; this soap only contained 38·7 per cent. of water, and I found, as is by no means unusual with soda soaps, that this soap is becoming more dry. Potassa soaps made with pure alkali always are liable to absorb moisture, especially if made from oils only without admixture of tallow or resin. I prepared a lead soap by directly saponifying the oil with oxide of lead, as well as by precipitation from the potassa soap by means of a dilute solution of acetate of lead; 100 parts of potassa soap yielded 57·19 of dry lead soap. The dark colour of the oil is conspicuous in all these soaps, but less so in the soda soap; still, where the colour is no objection, the crude oil might perhaps be profitably applied for making a cheap lead plaster. As regards the so-called refining of the oil, *i.e.*, the abstraction of the dark colour accompanied by improvement in taste, I found that a simple expedient will have the desired effect, viz., washing of the oil with a solution of caustic potassa or soda; but in nearly every case it will be previously necessary to submit the oil to a thorough steaming and washing with boiling water, so as to remove from the oil as much as possible the mucilaginous and albuminous matters met with in the crude oil, sometimes to a very large amount: if this precaution is neglected there will be more waste—that is to say, that a larger quantity of alkali is required, and in consequence thereof a larger proportion of the more solid fatty matter of the oil is abstracted. It appears to me that the action of the alkali (it even acts at ordinary temperature of the air) is not simply the rendering soluble of the dark colouring matter in water, but a portion of the oil is saponified, viz., the more solid fat it contains; while with the abstracting of the colouring matter the glycerine also appears to be abstracted. The mixed liquids—alkaline lie and oil—after having been thoroughly beaten up together separate in three distinct layers on being left to repose; the upper one is the nearly colourless, so-called refined oil, the middle layer is the still yet dark coloured, saponified solid fat of the oil, while at the bottom is found the dark almost black coloured alkaline lie. Owing to the great discrepancy of impurity of the crude oil (some being evidently pressed from damaged seed) it is not well possible to say correctly what yield of purified oil will be obtained. I found under the most favourable circumstances that 100 parts of the previously steamed oil yielded from 85 to 88 parts of refined oil.

I made elementary analyses of the crude oil and two lead soaps—viz., one obtained directly, the other by precipitation from the potassa soap, the result being as follows:—

	Lead soap (direct).	Lead soap (precipitated).
Carbon . . .	32·41	44·811
Hydrogen . .	4·62	6·808
Oxygen . .	6·77	13·381
Oxide of lead .	56·20	35·000
	100·00	100·000

	Crude oil.
Carbon . . .	73·85
Hydrogen . . .	11·05
Oxygen . . .	15·10
	100·00

I must hereby observe that the two soaps were made from different (not the same) samples of oil, and that the crude oil, the elementary analysis of which is herewith appended, is a different sample again, which had not been submitted to any treatment, save filtration through paper at 212° to assist its running through. This oil as well as other samples I tested, distinctly yields with Lassaigne's test the reaction for nitrogen, though not in sufficient quantity for estimation.

The ultimate constituents of this sample of crude oil approach to those of castor oil (also a drying oil) which is as follows:—

Carbon	74·15
Hydrogen . . .	11·03
Oxygen . . .	14·78

The potass soap analysed a short time ago, after having been gradually taking up water, gave as result of analysis :

Water	65·740
Potassa	9·296
Fatty acids and colouring matter	24·964
	100·000

I have by various means tried to obtain directly and quantitatively the glycerine contained in the crude oil, but have never succeeded in getting it (the glycerine) free from colour ; a series of experiments, made with due care, gave me results varying between 18·10 and 19·90 per cent. The crude oil gives off a very sweet smell, somewhat like treacle ; its taste, also, is very sweet, without being accompanied by any acidity. I have some reason to believe that the crude oil contains a peculiar kind of sugar, and this may account for the large amount of glycerine found.

I am, &c. Dr. A. Adriani.

The Sugar of the Future.

To the Editor of the Chemical News.

Sir,—In reply to your correspondent P. L. Simmonds, I request you to insert in your valuable paper the following remarks. Dr. de Vry in his note to me uses the expression *Canna indica*, a far more ancient Latin name given to sugar cane than the name *Saccharum officinarum*, first introduced by Linnæus. The French still often say *Cannes des Indes* in speaking of sugar cane. I am certain Dr. de Vry as well as myself are aware of the enormous quantity of sugar consumed per annum throughout the globe, and I am also sure Dr. de Vry knows, as well as anybody else, what soil is needed for rice during a portion at least of its time of development, but Dr. de Vry evidently included in the general term rice other cereals.

Although the Arenga palm sugar is spoken of as sugar of the future, it may be so distant a future that to your correspondent as well as to many of the present day may apply the words of the well-known University song, "*Ubi sunt qui anti nos in mundo fuere?*"

I am, &c. Dr. A. Adriani.

P.S.—I enclose Dr. de Vry's original letter as *pièce d'évidence justificative.*

[We have verified Dr. Adriani's translation, or rather transcription, by a reference to Dr. de Vry's original letter, in which the latter certainly writes *Canna indica*. It is unfortunate that the same term should be used to indicate both the sugar cane and the plant which furnishes *tous-les-mois*.—Ed. *C. N.*]

The Chemical Report.

To the Editor of the Chemical News.

Sir,—Mr. Foster is quite wrong in supposing that any error he may have made led me into mistake. The facts are, as I stated, that I called repeatedly at Messrs. Bell and Daldy's, and inquired for the Report, the last time as soon as I knew it was in circulation, and then I was distinctly informed—or, at all events, I supposed so at the time—that there were none for sale separate from the volume.

As the matter stands, I should rather like to know how many days the Report was on sale separately, and what steps the Society of Arts took to make known the fact.

I am, &c. A Chemist.

February 15.

To the Editor of the Chemical News.

Sir,—In answer to Mr. Le Neve Foster's letter in your last week's Chemical News, and in verification of your own remarks in reference thereto, I beg to say that two or three friends of mine who had seen a copy of the Report, Class II., Section A (which was kindly sent me by the learned author), were each anxious to obtain a copy for themselves, and, applying each through their own bookseller, they were informed, in due course, that the Report in question was not sold only in connection with the "whole Report of the Exhibition."

I am, &c. J. M.

Burton-on-Trent, February 21.

Deposit in Brewers' Casks.

To the Editor of the Chemical News.

Sir,—Upon the occasion of a recent visit to a porter brewery in this city, I noticed on the lids of the cleansing casks a hard, brown crust, which seemed to me of a nature requiring chemical examination. I accordingly scraped off with a knife about 250 grains of it ; and upon testing it at my leisure, was surprised to find that it, in the main, consisted of oxalate of calcium. The exact constitution of this deposit was the following :—

Water	38·96
Organic matters	12·70
Oxalate of calcium	39·94
Soluble salts	8·30
Silox	0·10
	100·

Some scientific friends to whom I have mentioned this fact look upon it as novel, and possessed of some interest in connection with the subject of fermentation. Should you participate in this view, I will thank you to allow this notice a place in the columns of the Chemical News. I may, in conclusion, observe that at the time when I collected the oxalic deposit, there was much complaint in relation to the rapid souring of the porter of the brewery, and that a very considerable pecuniary loss had thereby been sustained by the proprietors of the establishment.

I am, &c., James Apjohn.

South Hill, Blackrock, February 18.

MISCELLANEOUS.

Royal Institution.—The following are the arrangements for the ensuing week :—Monday, February 27, at 3 o'clock, Professor Tyndall, F.R.S., "On Electricity." Tuesday and Thursday, February 28 and March 2, at 3 o'clock, Professor Hofmann, F.R.S., "An Introduction to Chemistry." Wednesday, March 1, at 3 o'clock, Professor Marshall, F.R.S., "On the Nervous System." Friday, March 3, at 8 o'clock, James Fergusson, Esq., F.R.S., "On the Temple and Holy Sepulchre at Jerusalem."

London Sewage.—The Corporation of London, unwilling to give up the idea of the enormous value of London sewage, and relying on the figures and fancies of Liebig, have agreed on a strong report against the arrangement of the Metropolitan Board of Works with Messrs. Napier and Hope, which, if carried out, they say, would be a glaring violation of the laws of agriculture, producing the smallest increase of food, and the smallest return to the ratepayers. They ask for yet another Parliamentary inquiry into the economic utilisation of sewage.

Researches of M. Stas.—A full account of M. Stas' earlier determinations of the atomic weights of elements, and also his later researches on the laws of chemical proportions, the author kindly informs us, will be placed in our hands in about three months, when we shall reproduce them as fully as possible. It may be said without fear of question that for rigorous exactitude these are the most important contributions ever made to our knowledge of the subjects to which they relate. In the first series the author sought to determine whether the laws of chemical proportions were absolutely exact or merely limited laws. He has here demonstrated that these laws are *mathematical*, as all chemists have hitherto believed, but no one before proved. Mere analysis and synthesis, as the author states, could never prove this; and he has, therefore, resorted to other means of proof, which will be found described in his memoir. In a second series he sought to determine whether the atomic weight of silver was constant, when deduced from the iodide, bromide, and chloride. The memoir describing these researches will give some important improvements in the methods of effecting the analysis and synthesis of these bodies, these new methods affording the means of accurately determining the errors of each operation. The third memoir extends and confirms the author's previous researches on nitrogen, chlorine, potassium, and sodium, and adds lithium to the bodies examined. The publication of these memoirs will remove the last doubts (if any chemist entertains them) of the inaccuracy of Prout's law.

Note on Tobacco Smoking.—Tobacco smoking is a process of *distillatio per decensum*, in which the vapours of the substance submitted to distillation, are not, as is usually the case, caused to descend by their own tension, but by the downward flow of a current of air, induced by the continuous production of a partial vacuum beneath the distilled body. The air which enters the mouth of a pipe issues from its stem after passing through a layer of ignited tobacco, carrying with it, among other things, watery vapour, carbonic acid, and nitrogen, together with the vapours of, or the products of the action of heat on, nicotine, a gummy matter, a resinous body, and a bitter principle. The distilled products of course vary with the nature of the tobacco, and the treatment to which it has been subjected; the amount of watery vapour varies greatly. In a sample of Turkish tobacco which did not appear moist, more than 22 per cent. of water was found to be present by drying in an air bath at 95° C. If the contents of a pipe be partially smoked and then examined, three distinct layers will be found. The first and uppermost consists of the ash of tobacco; the second consists of carbonised tobacco—that is to say, of tobacco which has been submitted to the action of heat sufficiently intense to cause its volatile parts to pass away, but not sufficiently intense to cause the oxidation of its carbon; the third layer consists of tobacco unacted upon. If a pipe is smoked by means of an aspirator, and the distillate examined, the smoke is found to be alkaline, and a quantity of water collects in the recipient, in which are suspended dark flakes of brown matter, and upon which an amber-coloured oil floats. A greater quantity of this latter may be collected by heating to redness a meerschaum plug which has been in a pipe for some length of time. A plug which had been for some weeks in a pipe in which Turkish had been smoked, weighed 1·0670 gramme, after heating to redness, ·4850 gramme; a second, from a pipe in which Turkish and Latakia had been frequently smoked, weighed ·9710 gramme, and after heating to redness, ·3570 gramme. On first heating a plug, very dense, strongly alkaline, white fumes are given off at a high temperature, which quickly condense, partly to a brown solid, partly to a yellow oil. When tobacco is carbonised without access of air, the evolved vapours burn readily with a highly luminous flame. By placing a thermometer immediately in front of the stem-orifice of a pipe, which was smoked by an aspirator, the temperature of the issuing smoke was found to be 47° C. Smoke rings may be readily examined by watching the smoke as it ascends from a pipe bowl; rings are frequently seen to separate themselves from the rising smoke, both parallel and at right angles to the axis of the pipe bowl, and in intermediate positions. As the rings thus produced are only a few inches from the eyes, and as, moreover, the eyes can be readily brought immediately under them (by throwing back the head) we are able accurately to examine the movement of the rings from the moment of their formation to that of their dissolution.—*G. F. Rodwell, F.C.S.*

Camphor Water as a Solvent for Salts.—It is more convenient to measure a liquid than to weigh a solid; many salts are therefore kept in solution, but they are at the same time very bad keepers. A very simple and efficacious mode of keeping them is to use *aqua camphorata*, *i.e.*, a saturated solution of camphor in water, as the solvent. Placing a piece of camphor in a solution already made is equally good.—*Year Book of Pharmacy.*

The Sun's Ocean of Light.—When the sun is viewed through powerful telescopes, its surface—that is, the luminous envelope of the mass—is seen to have a peculiar mottled or curdy appearance. Arago proposed that this envelope should be called the Photosphere, a name now generally adopted. By the elder Herschel, the surface of this photosphere was compared to mother-of-pearl. Other astronomers have said that it resembles the ocean on a tranquil summer day, when its surface is slightly crisped by a gentle breeze, and an undulating play of light is reflected from these little billows. Irregular lines of light are sent back from the crests of the small waves, and lines of shadow indicate the hollows. Within the last few years Mr. Nasmyth has discovered a more remarkable condition than any that had previously been suspected. Examining the solar surface with a fine telescope of great penetrating power, this astronomer has discovered objects which are peculiarly lens-shaped. He himself describes them as more like "willow leaves" than anything else; but some other observers, since their discovery, have likened them to rice grains, and others, again, to some forms of Diatomaceæ. These leaved forms are different in size; they are not arranged in any order; they lie crossing each other in all directions; and they have an irregular motion amongst themselves. They are, says Mr. Nasmyth, "arranged without any approach to symmetrical order in the details, but rather (if the term may be used) in a sort of regular random scattering." They are seen approaching to and receding from each other, and sometimes assuming new angular positions, so that the appearance, resulting from the combination of simultaneous motions amongst those forms, has been compared to a dense shoal of fish, which, indeed, they resemble in shape. The size of those objects gives a grand idea of the gigantic scale upon which physical operations are carried out in the sun. They cannot be less than a thousand miles in length, and from two to three hundred miles in breadth. The most probable conjecture which has been offered respecting those leaf or lens-like objects, is that the photosphere is an immense ocean of gaseous matter in a state of intense incandescence, and that they are perspective projections of the sheets of flame. Whatever they may be, it is evident they are the immediate sources of solar heat and light.—*Popular Science Review.*

ANSWERS TO CORRESPONDENTS.

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Grease.—There is a chapter on the subject in Richardson and Watts' Technology, Vol. 1, Part III., No. 2.

Erratum.—No. 270, p. 51, *for* 31061·8966 *read* 31695·7110.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On a New Re-agent for the Separation of Calcium from Magnesium, by Edward Sonstadt, *Esq.*

When, in the ordinary course of qualitative analysis, carbonate of ammonium is used to separate calcium from magnesium, unless the former is present in notable proportion to the latter, a very insoluble double carbonate of magnesium and ammonium always accompanies the carbonate of calcium, if this is allowed sufficient time to form. If much magnesium and no calcium is present, the magnesium precipitate still falls after a while. Both metals are precipitated by this reagent, the only difference being that the calcium precipitate forms somewhat earlier than the magnesium precipitate. This fact is cursorily mentioned by Fresenius, more fully by Gmelin, and has recently been made the subject of special notice by Dr. Dyer. Calcium, therefore, can only be separated from magnesium by this re-agent by fractional precipitation, which necessarily involves loss of substance; and, in qualitative examination, the method is sure to mislead when the proportion of calcium present is small, unless it is controlled by other methods. The same remarks apply in substance to the two other methods of precipitation by sulphuric acid and alcohol, and by oxalate of ammonium. When a moderately strong solution of Epsom salts is treated with sulphuric acid and alcohol, the solution is mostly converted into a crystalline magma; and if it is desired to separate a small proportion of calcium, which we will suppose to be present, the magma must be filtered, dissolved, and subjected to the treatment again and again to separate the sulphate of calcium, when, if the quantity of that salt present be very minute, it must be wholly lost. Of course these remarks do not apply to solutions of calcium and magnesium salts containing much of the former, except in a modified degree. What is true of the sulphuric acid and alcohol process is true in a more extended sense of the oxalate of ammonium process. I have precipitated within a trace the whole of the magnesium present in a considerable quantity of solution of chloride of magnesium, simply by successive additions of oxalate of ammonium,—the solution being concentrated to its original bulk after the last addition of the re-agent. Yet, in working with this re-agent, the rule is, that enough of it must always be added to transform all the magnesium salt into oxalate, since oxalate of calcium is soluble in solution of chloride of magnesium. That some magnesium salt must precipitate with the lime salt under such conditions is obvious; and that it does so is well known, and is, though incompletely, provided for by the process being directed to be repeated upon the precipitate first obtained. This process, therefore, is also one of fractional precipitation, and for it to approach success, the operator must know pretty nearly beforehand how much calcium, in proportion to the magnesium present, he has to deal with. Nevertheless, it is unquestionable that in skilled hands, either of the two last processes is capable of giving close approximations to the truth, when the quantity of calcium present amounts to a few per cent. of the mixed salts. When the quantity of calcium is less than 1 per cent., I do not think it is possible to estimate it accurately by any of these processes; and when the proportion is larger, the processes are at least more troublesome, have a wider limit of experimental error, and are more apt to fail in less experienced hands than the analytical processes in use for estimating most of the other commonly occurring elements.

In common tungstate of sodium we possess a test for calcium which is probably equal in delicacy and in certainty to that of chlorine for silver, or of sulphuric acid for barium.

The action of this test, in a preliminary examination, requires to be ascertained—

(1.) With calcium solutions alone.

(2.) The presence of magnesium.

(3.) The presence of magnesium and ammonium salts, and of these with free ammonia.

(1.) The Behaviour of Tungstate of Sodium with Solutions of Calcium Salts.—A saturated solution of sulphate of calcium, taken at 13° C. remains perfectly clear on addition of an equal volume of a saturated solution of tungstate of soda for a short time. On warming, when the solution attains the temperature of 42° C., it becomes turbid, deposits a film upon the containing glass vessel, and soon after a dense precipitate falls. To ascertain the limit of the action of the test, the solution of sulphate of calcium was successively diluted to various degrees, and precipitates obtained, until the solution was so dilute that it contained but one part of sulphate of calcium in 114,000 parts water. A few drops of solution of tungstate of sodium were added, the solution warmed, and at 56° C., the solution became distinctly opalescent. An experiment was then made on the distilled water used for the dilution, but it gave no reaction. It was evident that it was possible to push the attenuation much further, and yet get indications of calcium. But this proportion ($\frac{1}{114000}$) is near the limit at which sulphate of calcium may be rendered distinctly visible. A solution of chloride of calcium behaves similarly. Sulphate of magnesium is not precipitated by tungstate of sodium, unless the solutions of the two salts are strong. The experiments were made with a solution of pure sulphate of magnesium, of specific gravity 1·114, and containing 11·283 per cent. of the anhydrous salt. The solution of tungstate of sodium was saturated (at common temperature), and contained about one-third its weight of dry salt. A mixture of equal parts of these solutions gave no precipitate in the cold, but quickly crystallised when warmed, the crystals being difficultly soluble, and leaving a very slight residue of an insoluble variety of tungstic acid, or of some compound of that acid. But when the mixed solutions above described were very little diluted, the solution remained perfectly clear at any temperature, until the fluid was concentrated by evaporation, when no precipitate, but clear crystals, appeared. It is only, therefore, in very concentrated solutions that tungstate of sodium gives—not then a precipitate—but crystals, with sulphate of magnesium. The chloride of magnesium solution behaves similarly, though it was not so closely examined.

(2.) The Behaviour of Tungstate of Sodium with Solutions containing Calcium and Magnesium.—The earlier experiments seemed to indicate that the presence of magnesium did not at all interfere with the precipitation of the calcium. But on continually diminishing the quantity of the calcium salt while that of the magnesium salt was kept constant, it was found that the latter exercised a very appreciable solvent power. The limiting experiment was as follows:—To 5 cc. of a solution containing 7 parts in 100,000 of sulphate of calcium were added 3 cc. solution of sulphate of magnesium, containing 11·283 per cent. anhydrous salt, 12 cc. water, and a few drops of tungstate of

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sodium. There were thus, in 2,000,000 parts of fluid, 35 parts sulphate of calcium, and 33,849 parts sulphate of magnesium—the remainder being water, except the small quantity of tungstate of sodium. The reaction was not visible till the fluid reached the temperature of 70° C., when it became apparent, and, on putting it aside to cool, a perfectly distinct film formed on the glass. A similarly attenuated solution of the lime salt, but containing no magnesium, was exposed to the same conditions with the re-agent, and the reaction in the latter case occurred earlier, at a lower temperature, and was more distinct. Nevertheless, the fact remains that, in a mixed solution of the sulphates of calcium and magnesium, the presence of the former may be clearly detected up to the proportion of about 1 part in 56,000 of fluid containing about 1000 parts of magnesium salt. Rougher experiments made with the corresponding chlorides led to similar results.

(3.) The influence of ammonium salts in obstructing the precipitation of calcium in presence of magnesium is very marked. A calcium salt, in presence of a very large proportion of both magnesium and ammonium salts, cannot be certainly recognised except somewhere near $\frac{1}{4000}$th of the calcium salt be present in solution. The influence of free ammonia with sulphate of ammonium and sulphate of magnesium, in like large proportions, is so great as to only just admit of the recognition of the calcium when from $\frac{1}{800}$th to $\frac{1}{1000}$th is present. Nevertheless, enough, and rather more than enough, ammoniacal salt may be present to prevent any precipitation of magnesium by excess of ammonia, and a moderate excess of ammonia may also be present, without sensibly affecting the estimation of the lime in a quantitative experiment. Chloride of ammonium does not dissolve the precipitate when it is once formed.

The analytical experiments on weighed mixtures of calcium and magnesium salts, imperatively necessary in introducing a new re-agent, are not yet completed, most of the experiments of this kind made till now having been vitiated through ignorance of the conditions necessary to ensure success. I give, however, the results of one experiment, the conditions of which approached more nearly to those I now know of as being necessary than the others, reserving the series, together with the methods adopted for obtaining pure materials to work with, for a second paper.

	Taken.	Found.
Magnesia	0·3097 grms.	0·3120
Carbonate of calcium .	0·0043	0·0042

The weighed quantities of carbonate of calcium and of magnesium were dissolved in a slight excess of hydrochloric acid; neutralised carefully by ammonia, precipitated by tungstate of sodium, and then the filtrate, with the usual precautions, by common phosphate of sodium. The excess in the weight of pyro-phosphate of magnesium led to the suspicion that some tungstic acid had been carried down—a suspicion amply confirmed by the colouration obtained from the solution of the ignited precipitate in dilute hydrochloric acid when treated with tin.

A little in anticipation of my intended future paper upon the subject, I now add such details respecting the manipulation required in separating lime from magnesia by tungstate of sodium as my experience has shown to be necessary. It is convenient to have the solution of the magnesium and calcium salts made somewhat alkaline by ammonia, but a very large quantity of this, as well as of ammoniacal salt, is, as we have seen, to be avoided. The beaker in which the precipitation is to be effected should, while perfectly dry and warm, be rubbed within by chamois leather on which a drop or two of fine oil (such as is used for oiling balances) has been put. If this precaution be not taken, it will be found impossible to detach the precipitate of tungstate of calcium from the sides and bottom of the vessel. A considerable excess of the re-agent is not necessary; but, if it occur, is not material. If, on addition of the re-agent, a white, flocculent precipitate forms immediately, it is well to add a few drops of ammonia, when the flocculent precipitate will re-dissolve; but if it does not re-dissolve, after warming, there is some other element present, which, if ordinary Epsom salts are used, will probably be manganese. The tungstate of calcium precipitate is very dense; it forms slowly in very dilute solutions, and, in all cases, several hours should be allowed for it to form. The solution should be warmed meanwhile, but must not be allowed to boil. The precipitate must be washed till the filtrate shows no cloudiness on standing with nitrate of silver, when the salts are chlorides; or if they are sulphates, till chloride of barium gives no cloudiness. The precipitate must then be further washed with dilute solution of ammonia, but these washings need not be saved. The filter should be burnt separately, after the precipitate is cleared from it as nearly as possible. After the ignited precipitate is weighed, a little strong solution of ammonia should be poured upon it, and allowed to stand for awhile, when the ammonia is decanted, and supersaturated with acid. If a precipitate falls after a time, the tungstate of calcium precipitate should (without being removed from the crucible) be allowed to stand for some hours with more ammonia—it is then washed by decantation, again ignited, and weighed. The ignited precipitate should be perfectly white.

The filtrate, containing the magnesium salt and tungstate of sodium, may be at once precipitated by phosphate of sodium in the usual way; but if this is done, much washing is required to get rid of the little tungstic acid that adheres obstinately to the precipitate. It is better, especially when a great excess of the re-agent has been used, to first precipitate the tungstic acid by a considerable excess of hydrochloric acid, and boil until the precipitate becomes dense and intensely yellow. The solution is then filtered, supersaturated with ammonia, and the magnesia precipitated in the usual way; but, even in this case, it is better to wash lastly with stronger ammonia solution than ordinary.

An Introduction to Chemical Philosophy, according to the Modern Theories, by ADOLPHE WURTZ, *F.R.S.*

PART I.

EQUIVALENTS, ATOMIC WEIGHTS AND MOLECULAR WEIGHTS.

SECTION I.—*Historical Development of the Ideas, Equivalent, Atom, Molecule.*

(Continued from page 86.)

Berzelius's Atomic Weights and Notation.—The important researches of this Swedish chemist on equivalents and atomic weights date from almost the same period as do those of Dalton. In 1807, whilst he was preparing the first edition of his *Traité de Chimie*, he happened to read Richter's forgotten work, and called the attention of chemists to the laws which govern the composition of salts.

Richter had stated that for the same class of salts there existed a constant relation between the proportion of acid and the amount of oxygen in the base. Berzelius confirmed this statement, and put it in a simpler form by proving that for the same class of salts there existed an uniform and simple relation between the amount of oxygen in the acid and of oxygen in the base. Thus he showed that in neutral sulphates this proportion was as 3 to 1, in nitrates as 5 to 1, and in neutral carbonates as 2 to 1.

Here the principal achievement is less, perhaps, in propounding a law than in the superiority of the analyses. Bergmann had made several analyses, and Wenzel had made some tolerably exact ones, but no one had yet arrived at the same degree of accuracy as did Berzelius, the father of our modern analytical processes. He commenced his works in 1808, and in 1815 he was enabled to give a table of atomic weights based upon his own determinations, and much more accurate than those of his predecessors. He compared the atomic weights with that of oxygen, which he called 100; that of hydrogen was 6·24. The influence of Gay-Lussac's discoveries on fixing the atomic weights is here clearly shown. In fact, the ratio of the atomic weights, 100 to 6·24, or 16 to 1, is that of their densities. Wollaston had given for the *equivalents* of hydrogen and oxygen numbers which were not very different from those of Dalton. These numbers, which represented the proportions by weight according to which oxygen combines with hydrogen, are true equivalents, whilst Berzelius's numbers, which express the proportions by weight which exist between equal volumes of hydrogen and oxygen, are true atomic weights. But this distinction is shown still more clearly in the chemical notation which Berzelius brought into use. Dalton represented the composition of water by the symbol ⊙ ○, in which ⊙ represented one atom of hydrogen and ○ one atom of oxygen. Berzelius expressed this composition by the formula H_2O, in which H_2 represented two atoms of hydrogen and O one atom of oxygen. He also made use of an abridged notation. Thus the formula of water was written Ḣ̶, the letter H̶ representing two atoms of hydrogen and the dot one atom of oxygen. Moreover, Berzelius attached a particular meaning to these barred symbols; they represented what he termed double atoms. According to him, two atoms of hydrogen H̶ or two atoms of chlorine C̶l were looked upon as inseparable as they entered together into combination. Thus, one double atom of hydrogen (two atoms) entered into combination with one single atom of oxygen. One double atom of hydrogen entered into combination with one double atom of chlorine. Berzelius wrote the formula of water Ḣ̶ = H_2O; that of hydrochloric acid H̶C̶l = H_2Cl_2; that of ammonia $\text{NH̶}_3 = N_2H_6$; that of chloride of calcium CaC̶l = $CaCl_2$. In certain cases, therefore, the double atoms represented the quantities which entered into combination—that is to say, the equivalents. The idea of double atoms is not now adopted in the sense in which Berzelius used it. But it is necessary to observe one thing, which is, that having taken as unity one atom of oxygen, he admitted that the atoms of hydrogen, chlorine, nitrogen, phosphorus, arsenic, &c., only represented half an equivalent, and that it was necessary to take a double atom (or two atoms) of these bodies to make one equivalent. This conclusion was perfectly logical. In the tables which the illustrious Swedish chemist gave there are seen, besides the simple atomic weights, certain double atomic weights, which represent the proportions according to which bodies enter into combination or their equivalents. These are the numbers given by Berzelius:—

	Atomic Weights.		Equivalents.	
	Symbols		Symbols	
Oxygen . .	O	100	O	100
Hydrogen . .	H	6·24	H̶	12·48
Nitrogen . .	N	87·53	N̶	175·06
Fluorine . .	Fl	117·717	F̶	235·435
Chlorine . .	Cl	221·64	C̶l	443·28
Bromine . .	Br	499·81	B̶r	999·62
Iodine . . .	I	792·996	I̶	1585·992
Sulphur . .	S	200·75	S	200·75
Selenium . .	Se	495·285	Se	495·285
Tellurium . .	Te	801·76	Te	801·76
Phosphorus . .	P	196·0205	P̶	392·041
Arsenic . .	As	469·40	A̶s	938·80
Carbon . .	C	75·12	C	75·12
Boron . . .	Bo	136·204	Bo	136·204
Silicium . .	Si	277·778	Si	277·778
Potassium . .	K	488·856	K	488·856
Sodium . . .	Na	289·729	Na	289·729
Lithium . .	Li	81·66	Li	81·66
Calcium . .	Ca	251·651	Ca	251·651
Barium . . .	Ba	855·29	Ba	855·29
Strontium . .	Sr	545·929	Sr	545·929
Magnesium . .	Mg	158·14	Mg	158·14
Aluminium . .	Al	170·90	A̶l	341·80
Glucinum . .	Gl	87·124	G̶l	174·248
Zirconium . .	Zr	419·728	Z̶r	839·456
Magnesium . .	Mn	344·684	Mn	344·684
Chromium . .	Cr	328·87	Cr	328·87
Uranium . .	U	742·875	U	742·875
Iron . . .	Fe	350·527	Fe	350·527
Cobalt . . .	Co	368·65	Co	368·65
Nickel . . .	Ni	369·33	Ni	369·33
Zinc . . .	Zn	406·591	Zn	406·591
Cadmium . .	Cd	696·767	Cd	696·767
Copper . . .	Cu	395·60	Cu	395·60
Lead . . .	Pb	1294·645	Pb	1294·645
Bismuth . .	Bi	1330·377	B̶i	2660·754
Tin . . .	Sn	735·294	Sn	735·294
Titanium . .	Ti	301·55	Ti	301·55
Tungsten . .	W	1188·36	W	1188·36
Molybdenum .	Mo	596·10	Mo	596·10
Antimony . .	Sb	806·452	S̶b	1612·903
Mercury . .	Hg	1251·29	Hg	1251·29
Silver . . .	Ag	1349·66	Ag	1349·66
Rhodium . .	R	651·692	R̶	1303·924
Palladium . .	Pd	665·477	Pd	665·477
Platinum . .	Pt	1232·08	Pt	1294·645
Iridium . .	Ir	1232·08	Ir	1232·08
Osmium . .	Os	1242·624	Os	1242·624
Gold . . .	Au	1129·165	A̶u	2458·33[*]

The principles which guided Berzelius in the determination of the atomic weights are simple, and his processes are exact. He varied the latter and controlled them by one another. He thus learnt, as he modestly said,[†] to discover the faults that he had at first committed, and at last had the satisfaction of finding an

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[*] The numbers here given are not those which appeared in the first tables of Berzelius. We have thought it best to give the atomic weights which he finally adopted, and we have extracted them from the last German edition of his great work (Appendix to vol. iii. "Tabulæ Atomicæ"). Amongst the equivalents of the metals, it will be remarked that those of aluminium, glucinum, bismuth, antimony, rhodium, and gold are double their atomic weights. Berzelius supposed that the combination of those bodies contained at least two atoms of metal. Thus he wrote—A̶lO_3, A̶lC̶l_3, B̶iO_3, B̶iC̶l_3, S̶bO_3, S̶bC̶l_3, R̶C̶l (protochloride of rhodium), A̶uC̶l (protochloride of gold), A̶uC̶l_3, &c. It is seen that in all those compounds the amount of metal which enters into combination (improperly termed its equivalent) is represented by two atoms.

[†] *Lehrbuch der Chemie*, 1845, iii., 1160.

accurate agreement between the results of analysis and theoretical calculations.

In general he considered the atomic weight of a metal to be the quantity of this metal which combined with 100 of oxygen to enter into the first degree of oxidation. He deviated from this rule, however, in certain cases.

Thus he considered that the atomic weights of copper and of mercury are represented by the amounts of these metals which combine with 100 of oxygen to arrive at the second degree of oxidation. Since 1826[‡] he represented the composition of the oxides of copper and mercury by the formulæ

Cu_2O,	CuO;	Hg_2O,	HgO.
Cuprous oxide.	Cupric oxide.	Mercurous oxide.	Mercuric oxide.

Amongst the reasons which led him to deviate from the rule given above may be given two which possess considerable importance.

In 1819 and 1820 were announced two great discoveries which have exercised a marked influence over the development of the atomic theory.

The first according to date is that of Dulong and Petit, concerning the relations which exist between the specific heat of simple bodies and their atomic weights; the second, which is due to Mitscherlich, is that of isomorphism.

(To be continued.)

The Influence of Lodes on Rocks,[§] *by* R. Pearce, *Esq.*

It is a fact well known to most miners that the granite which is found near lodes is frequently different, both in composition and general character, from the granite which is met with at some distance from the lodes. To be convinced of this fact, we have only to observe the granite in the quarries at the summit of Carn Marth, and compare it with a sample of rock from the base of the hill near Wheal Damsel. Many other districts in Cornwall offer fine examples of these rock changes. The conditions are not the same in every district; the various kinds of alterations being effected perhaps by local causes. If we observe carefully the joints in granite quarries, we find that the walls of these joints are often coated with crystals of schorl, and the felspar of the granite near the joints is sometimes replaced by this mineral, or much discoloured from the presence of oxide of iron; showing that these small fissures are sufficient in many cases to produce a number of important changes both in the composition and general appearance of the granite. It is found, too, that the direction of the joints materially affects the characters of the mineralogical changes which take place; thus, for example, in the quarry at Carn Marth, the joints having a bearing about 25 deg. S. of W., contained amethyst, fluor spar, and chlorite; whilst in those joints having a direction 10 deg. W. of N. nothing but schorl and oxide of iron could be detected. At Trelubbas quarry, Wendron, this was still more strikingly shown; the joints having a bearing 20 deg. S. of W. were found to contain chlorite, copper pyrites, white mundic, and blende; while, on the other hand, those which had a contrary direction were perfectly free from those minerals, and contained nothing but schorl and oxide of iron. In the St. Just district precisely analogous conditions may be found. These mineralogical changes may be seen, however, on a much larger scale in granite and elvan when found in close proximity to mineral lodes. Take, for example, the mining districts of St. Just, St. Ives, Wendron, Redruth, Gwennap, and Liskeard, and we find that although there may be a difference in the mineralogical character of these changes, yet there is no difficulty in tracing their origin to the effect of mineral lodes. There is no doubt but that similar changes may be found in our stratified rocks, but these do not offer the same advantages for observation as the crystalline rocks which I have named—granite and elvan.

One of the most common forms of these alterations is the change of one or more of the constituents of granite (felspar, quartz, and mica) into chlorite; this may be observed in almost every metalliferous district in the county where granite occurs. The mineral which is most commonly metamorphosed is felspar, as it appears to be less capable of resisting the solvent action of water than the other minerals—quartz and mica. It is not common, however, to find well-formed pseudomorphs of chlorite after felspar. I have observed them recently in the granite near Carn Marth, and also in an elvan course at the Consolidated Mines, Gwennap.

My attention was first directed to this elvan course by Mr. Enys, who had noticed some of its peculiar characters for a long time. It appears to have undergone a series of very interesting changes. The first alteration appears to be the conversion of the amorphous felspar into quartz, leaving the crystalline felspar intact; the next change is the substitution of the crystalline felspar by chlorite. It is very evident that the crystalline felspar is extremely liable to alteration, for we find that simple exposure to atmospheric influences is sufficient to cause it to disintegrate and change into kaolin or china clay. In one or two instances Mr. Saltren Rogers and myself have observed that the replacement of the felspar by chlorite has commenced in the centre of the crystal. These changes may be seen in all their stages in the elvan rocks on the surface, at the afore-mentioned mine. The replacement of felspar in granite by chlorite is well shown in the mining districts of Gwennap, Camborne, and Redruth, St. Ives, and also in the Caradon Mines; and there are strong evidences of the formation of lodes by the alteration of the granite. I have seen tin lodes near St. Austell which consist of altered granite (schorl, quartz, mica, and oxide of tin). The tin lodes in many of the St. Just mines exhibit satisfactory proofs of having been formed by the metamorphism of the granite in which they occur. Examples of this kind may be seen also at Dolcoath and many other mines.

The above facts would lead us to believe that there is a relation between the natural joints of rocks and mineral lodes; for we have strong grounds for supposing that many of the lodes in Cornwall and elsewhere have been formed by the infiltration of water (containing in solution the various minerals) through the natural joints, producing in its passage the changes which are seen. The discovery of copper and associated minerals at Trelubbas quarry in the joints having a direction 10 to 20 N. of E. and S. of W. (whilst those minerals were entirely absent in the joints running in a contrary direction) indicates that these minerals are deposited in the joints having about the same direction as the principal lodes of Cornwall. The lodes which are seen at Priest's Cove, St. Just, in the granite, have all been formed in the natural joints of that rock.

Schorl, fluor spar, oxide of tin, and iron pyrites, are found sometimes replacing one or more of the ordinary constituents of granite and elvan. Pseudomorphs of oxide of tin after felspar have been met with in the

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[‡] In 1815 he took for certain metals double the atomic weights that he adopted later; thus, at this period he wrote:

FeO_2,	FeO_3;	CuO,	CuO_2;
Ferrous oxide.	Ferric oxide.	Cuprous oxide.	Cupric oxide.
HgO,	HgO_2;	PbO_2;	AgO_2, &c.
Mercurous oxide.	Mercuric oxide.	Plumbic oxide.	Argentic oxide.

[§] A paper read before the Cornwall and Devon Miners' Association.

elvan course at Wheal Coates (St. Agnes), and in the granite at Balleswidden Mine, St. Just; it has been found replacing the felspar in the granite near the foot wall of the lode at Phœnix, and also at Dolcoath, but in this instance the quartz of the granite has been substituted by this mineral.

The replacement of felspar by schorl is of very common occurrence; it is not only seen in districts where mineral lodes abound, but occurs frequently at the junction of the granite with the slate. On the north side of Cape Cornwall, where these rocks join, may be seen huge blocks of granite, the felspar of which has been partly, and sometimes entirely, replaced by schorl; the same change may be seen at St. Ives, and also in the parish of St. Enoder. At the latter place perfect pseudomorphs of schorl after felspar may be found; the felspar has been converted into china clay, which occurs in large quantities in the district. I have observed some interesting pseudomorphs of schorl after felspar in an elvan course at Poldice. The presence of iron pyrites in granite is of great interest. I have observed it recently in the Wendron district, near Wheal Trumpet and Old Wheal Mount mines; the mundic occurs in isolated cubes diffused equally throughout the rock, but only in close proximity to the lodes.

I think we must either ascribe the existence of this mineral in the granite to the influence of the lodes passing through it, producing this metamorphism, or discard the theory of its igneous origin; because it is well known that bisulphide of iron (iron pyrites) cannot exist at the temperature of fused granite. From the peculiar character of the rock, and its relation to the lodes, I should certainly be inclined to adopt the former opinion. The crystals of mundic, on exposure to the atmosphere, become converted into pseudomorphs of red oxide of iron.

It is difficult to account for the various changes which I have named. It is, however, evident that water plays the chief part; and probably the substances produced by the destruction of one mineral reunite to form the mineral which takes its place. If we compare the chemical composition of felspar with chlorite, we find that the only difference is, the substitution of potash and a portion of the silica of the felspar, by magnesia, oxide of iron, and water. We find that the water which circulates through the fissures and joints of rocks frequently contains both these substances (oxide of iron and magnesia) in solution, and we also know that felspar is a mineral which under certain circumstances is readily decomposed, yielding up its potash, so that there is little difficulty in accounting for the change of felspar into chlorite; heat would also very materially assist in bringing about these changes. At the Clifford Mines, Gwennap, where we find the elvan metamorphism so well shown, the temperature of the water coming from the lode is very high (it registered a few months since 125°). This, I have no doubt, accounts in a great measure for the rapid decay and repair to which the rock has been subjected. I have every reason to believe (after a number of careful observations) that the capel of lodes has been formed from the decay of minerals which enter into the composition of the rocks adjoining. A number of careful analyses of capel from districts, would, I have no doubt, greatly assist in explaining this point.

The facts which I have noticed in this paper may appear to have little practical bearing in a mining point of view. I am convinced, however, that the subject is an important one, and, if diligently investigated, must assist in explaining some of the laws which regulate mineral deposits.

On the Separation of Chromium from Aluminium, Iron, Manganese, Cobalt, Nickel, Zinc, and Magnesium, by Wolcot Gibbs, *M.D., Rumford Professor in Harvard University.*

Sesquioxide of chromium in an alkaline solution is readily oxidised to chromic acid by means of chlorine, bromine, or deutoxide of lead. When chlorine or bromine are employed as oxidising agents, the alkaline solution may be neutralised by acetic acid after the oxidation is complete, and the chromic acid may then be precipitated by acetate of barium, when the solution is free from sulphuric acid, and directly weighed in the form of chromate of barium. In place of free alkali, it will be found in practice very much more convenient to employ acetate of sodium or potassium. When a solution of sesquioxide of chromium is rendered nearly neutral by a solution of carbonate of sodium, and acetate of sodium is added in excess, a current of chlorine gas, or a solution of chlorine water, readily converts the whole of the chromium present into chromic acid, especially when the solution is hot, and when it is kept nearly neutral by occasional addition of carbonate of sodium. The excess of chlorine is easily expelled by boiling. After which, in the presence of bases not precipitated by ammonia, the chromic acid may be precipitated by acetate of lead, or acetate of barium, and weighed in the form of chromate—provided, of course, that no sulphuric acid is present. When sulphate and chromate of barium are thrown down together, the chromic acid may be reduced to sesquioxide by boiling with concentrated chlorhydric acid and alcohol, after which the barium may be precipitated by sulphuric acid, and the sesquioxide of chromium thrown down in the filtrate by boiling with ammonia in the usual manner. As the reduction of chromate of barium by means of chlorhydric acid and alcohol does not take place very readily, it is better to boil the chromate with an excess of carbonate of potassium or sodium, to filter off the carbonate of barium, and determine the chromic acid by means of nitrate of suboxide of mercury, or by reduction to oxide of chromium and precipitation with ammonia in the usual manner.

When aluminum and iron are to be separated from chromium by this process, the two oxides may be precipitated together by simply boiling the solution after the complete oxidation of the chromium to chromic acid, in the presence of excess of acetate of sodium. It is more convenient and equally accurate to neutralise the solution with ammonia, separate the alumina and sesquioxide of iron by filtration, and determine the chromium in the filtrate by reduction and precipitation with ammonia.

When the oxide of calcium, magnesium, zinc, nickel, cobalt, and manganese are present in a solution containing sesquichloride of chromium, it is best to oxidise the chromium to chromic acid as above, and then to precipitate with acetate of lead or barium.

I have stated in a former paper that chromic iron ore may be completely resolved by fusion with fluohydrate of fluoride of potassium. In this and in all similar applications of the fluohydrate it is best to evaporate the finely-pulverised mineral to dryness with a concentrated solution of the salt. On subsequently heating to low redness, the resolution of the mineral is effected with the utmost ease, a portion of the chromium being usually oxidised to chromic acid by the oxygen of the air. After expelling the fluorine by heating the fused mass with sulphuric acid, the remaining mass may be treated with acetate of sodium and chlorine in the manner already pointed out, the iron and aluminium separated by boiling, and the chromic and sulphuric acids precipitated by acetate of barium, after which the chromium may be determined as above.

In precipitating chromic acid by means of nitrate of suboxide of mercury, hot solutions must not be employed, as a small portion of chromic acid is always reduced to sesquioxide of chromium. The precipitated chromate should be allowed to stand some hours before filtering. In general the precipitation by acetate of lead or acetate of barium is to be preferred even when the resulting chromate is to be weighed as such.—*American Journal of Science and Art, January, 1865.*

On the Employment of Acetate of Sodium for the Separation of Iron and Aluminium from other Bases, by WOLCOT GIBBS, *M.D., Rumford Professor in Harvard University.*

THE facility with which iron and aluminium are precipitated from neutral solutions of the sesquioxide by boiling with acetate of potassium or sodium has led to frequent analytical applications, though the method is not so generally employed as it deserves. Mr. C. F. Atkinson has devoted much time to a careful study of the subject, and has arrived at the following results, which appear to me worthy of attention:—

The sesquioxides of iron and aluminium may be perfectly separated from the protoxides of manganese, cobalt, nickel, zinc, magnesium, and calcium, and from sesquioxide of uranium, by boiling the neutral or nearly neutral solutions with acetate of sodium, provided that the following precautions are observed:—The solutions from which the sesquioxides are to be precipitated must be dilute; half a litre of the solution should not contain more than one grain of either sesquioxide or of the two, when both are present. The quantity of acetate of sodium should be sufficient to convert by double decomposition all the bases present into neutral acetates. The acetate should be added to the metallic solution when cold, and the whole should then be heated together and boiled for a short time. It is not necessary to filter upon a water-bath funnel, but the beaker containing the solution should be kept nearly at the boiling point during filtration, and a ribbed filter should be employed. In all cases it is best to add a few drops of free acetic acid to the solution, to prevent the formation of basic acetates of the protoxides. This is especially necessary in separating iron and aluminium from zinc and nickel.

Finally, it is best, whenever possible, to have all the bases present in the form of chlorides. The iron and alumina upon the filter in the form of basic acetates must, whenever an absolutely complete separation is necessary, be re-dissolved in chlorhydric acid, and again be precipitated by boiling with the acetate after rendering the solutions nearly neutral by means of carbonate of sodium. In this manner only it is possible to separate the last traces of the stronger bases. Finally, the basic salts of the iron and aluminium, after washing, must be re-dissolved in chlorhydric acid, and precipitated by boiling with ammonia in the usual manner, to free them completely from alkali. The precaution of a second treatment with acetate of sodium is more necessary with alumina than with sesquioxide of iron alone. It is scarcely worth the trouble in the separation of iron from calcium and magnesium.

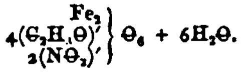
According to my own observations the sesquioxides of iron and aluminium cannot be separated from sesquioxide of chromium by boiling with acetate of sodium, although the last-mentioned oxide is not precipitated when alone in solution. In this case it is necessary to oxidise the chromium to chromic acid by chlorine in the manner already pointed out.—*American Journal of Science and Art, January, 1865.*

TECHNICAL CHEMISTRY.

*Analysis of an Iron Mordant,** *by M.* A. SCHEURER-KESTNER.

I HAVE in a former note described the composition of an iron mordant employed to dye plush black. This mordant contained ferric oxide, acetic and nitric acids, and chlorine.†

I have since analysed another mordant, serving equally well for dyeing plush, and which is free from hydrochloric acid and chlorine. The solution as sold is of a dark brown colour, with a strong odour of acetic acid. When evaporated, if boiled too quickly it decomposes, and deposits ferric hydrate; but if properly and carefully exaporated, it gives a beautiful crystallisation of ferric diacetate containing nitric and acetic acids. When the evaporation has been properly effected, most of the solution can be transformed into crystals, which have on analysis given the numbers leading to the formula of ferric tetraceto-dinitrate—



$$\left.\begin{matrix}\mathrm{Fe}_2\\ 4(\mathrm{C}_2\mathrm{H}_3\Theta)'\\ 2(\mathrm{N}\Theta_2)'\end{matrix}\right\}\Theta_6 + 6\mathrm{H}_2\Theta.$$

PHOTOGRAPHY.

Chloride of Gold.‡

AT a time when so many complaints are being made by photographers of the impurity of the chloride of gold they employ, some details may be useful on the fabrication of this valuable product. Ordinary chloride of gold (perchloride of gold Au_2Cl_3) is obtained by dissolving gold in aqua regia, a mixture of one part of nitric acid and four parts of hydrochloric acid. By evaporating gently, crystals are produced of hydrochlorate of chloride of gold ($Au_2Cl_3 + HCl$). It is this salt, containing an excess of acid, which is often sold as chloride of gold. It is in the form of a light yellow crystal, while perchloride of gold, anhydrous and quite pure, is of a red-brown colour. If it is further heated to eliminate the acid, a brown mass is the result, but part of the perchloride is transformed into protochloride insoluble in water, Au_2Cl. We have thus either an acid salt or a considerable loss of gold. Pure perchloride of gold, decomposed at a high temperature, ought to give thirty-four centigrammes of pure gold for one gramme of salt. This result is never obtained with commercial perchloride, which, as we have said, contains either acid or water in excess, and is sometimes even adulterated with chloride of sodium; the latter is, however, easily recognised. By heating a little chloride of gold in a porcelain capsule, and, after cooling, pouring on it two or three drops of pure distilled water, and then heating slightly, a liquid is obtained, which, evaporated on a platinum plate, should leave no residue; and with which a drop of water and one of nitrate of silver ought to give no precipitate.

The great difficulty of producing this salt in a neutral and pure state has induced M. Fordos to propose the employment of double chlorides of gold and potassium

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* *Bulletin de la Société Chimique,* 1864, ii.

† *Repertoire de Chimie appliquée,* p. 470, 1863.

‡ *Bulletin de la Société Chimique.*

or gold and sodium, which are easily obtained, and are used in the same proportion as perchloride of gold.

To prepare double chloride of gold and potassium ($Au_2Cl_3.KCl + 5HO$), dissolve one gramme of gold in one gramme of nitric acid, and four grammes of hydrochloric acid. Evaporate to crystallisation, dilute with a little distilled water, and add 0·51 gr. of bicarbonate of potash; evaporate to dryness to expel the excess of acid; dissolve in a little distilled water; filter through asbestos; and crystallise by evaporation.

To prepare double chloride of gold and sodium ($Au_2Cl_3.NaCl + 4HO$), instead of 0·51 gr. of bicarbonate of potash, use 0·73 gr. of pure carbonate of soda.

Positives without Salts of Silver—M. Liesegang's Process with Ammoniacal Citrate of Uranium.*

M. Liesegang has for some time been endeavouring to substitute salts of uranium for salts of silver, and has succeeded in finding an extremely simple and certain process, giving, he says, superior results. He uses an ammoniacal uranium salt prepared in the following manner:—

Pour ammonia into a solution of nitrate of uranium, and a precipitate of uranate of ammonia will be formed, which must be carefully washed in distilled water, to get rid of every trace of nitric acid. Then dissolve it in citric acid.

Mix this solution of citrate of uranium and a little solution of chloride of gold with a paste prepared by dissolving tapioca powder in hot water. The quantity of chloride of gold must be small, and the heat not too great, otherwise the gold will be reduced.

Spread this mixture with a sponge on paper, which takes a brilliant yellow colour, similar to albumenised paper; when quite dried in the dark, place it in the positive frame. The proofs have all the force and delicacy of those obtained with albumenised paper; the preparation is very sensitive, and becomes more so if slightly moistened.

The proofs come from the frame in a proper state, and of a bluish black colour; they should not be toned, and should be fixed by being washed with rain water until the yellow colour of the paper completely disappears. The picture may be changed to purple by a solution of chloride of tin.

PROCEEDINGS OF SOCIETIES.

ACADEMY OF SCIENCES.

February 20, 1865.

Father Secchi made a communication "*On the Influence of the Atmosphere on the Lines of the Spectrum, and on the Constitution of the Sun.*" Further observations with a more perfect spectroscope have confirmed the opinion before published by the Reverend Father that the atmospheric lines are due to aqueous vapour. With regard to the constitution of the sun, he observes that the principal things seen on looking at it through Mr. De la Rue's eye-piece is that the luminous base of the sun is seen as a net work, over which a great number of white points are visible more or less elongated and separated by darker meshes, the knots of which appear to be small black holes; the white bodies, to which the shadows of the solar spots give a peculiar appearance, the author regards as masses of luminous clouds which certainly cannot be composed of aqueous vapour.

The commission appointed to review the experiments of M. Pasteur and his opponents, MM. Pouchet, Mussel, and others, relative to the question of "*Spontaneous Generation*" brought up a report. It was entirely in favour of M. Pasteur, and therefore opposed to the theory or facts of spontaneous generation. The report establishes that fermentable liquors may remain either in contact with confined air, or exposed to air which is often renewed without changing; and that if changes do take place, and organic beings are generated, this result cannot be attributed to the gaseous elements, but must be caused by solid particles introduced with air, and of which it may be completely deprived. Some of the experiments were objected to by the supporters of heterogenesis, and the commission will make further researches when warmer weather arrives.

M. Tresca, whose experiments of the flow of solid bodies (soft metals and ceramic pastes) from a small aperture when submitted to great pressure we have noticed before, has now extended his researches to ice. This body is found to issue in exactly the same way as the solids above mentioned. The jet is formed of perfectly distinct concentric tubes, which, however, in this case are grooved through their entire length with transverse fissures which gave to the jet the appearance of being made up of washers arranged one after another. The results support strongly Dr. Tyndall's theory of constitution of glaciers. Some effects resembling *moraines* were, indeed, seen when coloured ice was employed in the experiments.

M. Persoz read an abstract of a memoir "*On the Molecular State of Bodies, introductory to a General Theory of Compounds of Organic Origin.*" This work, which ought soon to be published at length, our readers will see is of great importance, since the author gives, among many other things, the peculiar characters which distinguish, in a molecular point of view, the bodies which polarise light from those which do not; the compounds which serve as alimentary matters from those which are not nutritious; the poisonous alkaloids from those which are innoxious; and lastly the carbon products, the radicals of which are the bases of colouring matters, natural or artificial." The author also applied to have a sealed packet opened which he deposited two years ago. It contained a description of *new (?) method of taking the specific gravity of solids.* It is as follows:—A known weight P of the body, the density of which is desired, is introduced into a flask of known capacity, V, full of air. The volume of the body will be given by that of the air displaced; so fill up the flask with water, or, of course, some other proper liquid, and measure carefully the quantity required. The volume required, v, subtracted from V, will give the volume of the body, and the density will be—

$$D = \frac{P}{V - v}$$

M. Chancel has studied the action of *Gypsum on Wines*, and has come to the following conclusions:—

1. That the gypsum takes into the wine in the shape of tartrate of lime half the tartaric acid which would otherwise remain in the marc.
2. That it increases the acidity of the wine, brightens the colour, and insures keeping.
3. That it introduces to the wine in the state of sulphate the greater part of the potash which would be found in the marc in the state of bitartrate.

A letter from Dr. Jackson to M. Elie de Beaumont described an apparently inexhaustible deposit of emery in the State of Massachusetts, much superior to that of Naxos.

CHEMICAL SOCIETY OF PARIS.

January 27.

M. Cloez, on presenting to the Society a small publication on the use of iodide of potassium as a test for ozone, took

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* *Moniteur de la Photographie.*

the opportunity of replying to a statement of Kosmann, that ozone was exhaled from plants. M. Cloez detailed some experiments he made ten years ago which satisfied him that the oxygen given off by plants is without action on ioduretted paper, and consequently not ozonized.

A communication by M. Jodin was read, "*On the Changes which take place in Vegetable Tissues under the Influence of Air and Light.*" A memoir by Kekulé, "*On the Constitution of Aromatic Substances,*" and a paper by Lieben, "*On Abnormal Vapour Densities,*" were also read.

NOTICES OF BOOKS.

The Philosophy of Health; or an Exposition of the Physiological and Sanitary Condition Conducive to Human Longevity and Happiness. By Southwood Smith, M.D. Eleventh edition, revised and enlarged. London: Longman and Co. 1864.

Dr. Southwood Smith was the Physician of the Utilitarian School. While Bentham and Mill concerned themselves with laws and morals as they influenced the well-being of a community, he recognised the great fact that sound health was at the bottom of individual happiness, and that to ensure "the greatest happiness of the greatest number" the first thing to do was to ensure them, as far as possible, healthy bodies. Seeing, too, that the conditions under which the mass of the population lived (and live) were not such as conduced to the healthy performance of bodily functions, he became a sanitary reformer. Knowing, also, that an acquaintance with the construction and operations of a machine are of the first importance to its proper regulation, he wrote his "Philosophy of Health," a popular manual of anatomy and physiology, and sought to disseminate among the people a knowledge of the principles upon which alone sound health can be maintained.

To a certain extent he was successful. The book in its earlier and cheaper form had a very large circulation. Towards the close of his useful life the author occupied himself with revising and extending the work—a task of no little labour when the advance made in our knowledge of physiology since the first publication is considered. Unfortunately he did not live to complete his task, and the work has been given to the world by a relative, who has not pointed out how far the author's revisal extended. Criticism is thereby disarmed, or we might point out places in which the best sources of information have been neglected.

This, however, will not interfere with the usefulness of the book as a popular guide. Its great recommendation is its *readableness*. Dr. Smith could make even the dry details of the bony structure of the body pleasant reading, and on this account alone we may strongly recommend the book to all who, without wishing to become professed anatomists, are yet anxious to have some acquaintance with the marvellous structure they inhabit. The anatomical part is now, indeed, the chief feature of the work, and with the assistance of the plates, introduced from Gray's Anatomy, a respectable knowledge of the subject may be gained by its perusal.

Physiological chemistry was in its infancy when Dr. Smith first wrote his book, and but little has been added on the subject in this edition.

The author's ideas of the power of chemistry to unveil the secrets of nature were limited, as will be seen by the following quotation:—

"So complete are the analyses which have led to the discovery of the facts now stated, that there is scarcely anything to be desired with respect to the knowledge of the ultimate composition of organic matter. Yet chemistry, which has so admirably displayed its analysis, has wholly failed to accomplish its synthesis. The chemist can analyse organic matter, but he cannot make it; not even a particle of sugar, the substance which stands on the very confines of the inorganic world. The plant can make it, so can the insect, but not the chemist. Some few of the binary inorganic compounds he has separated into their elements, and then by again combining them he has reproduced the substance he has decomposed. . . . But he cannot so recombine the elements of sugar or gum, of albumen or fibrin; yet he knows the exact proportions in which the elements unite to produce these substances, and he witnesses their actual transformation in every leaf that grows, in every flower that blooms; but the subtler process by which the change is effected he knows not and cannot imitate.

"He cannot do this because he cannot command, and does not even know, the conditions on which the formation of these substances depend. The chemistry by which these are generated is doubtless the same in its essential nature as that by which the crystal is produced; but organic substances, as already stated, can only be formed under conditions peculiar to life, and these conditions appear to be placed beyond human control and forbidden to human knowledge."

There is truth here, although the illustration is not well chosen. We may despair of ever seeing a granule starch produced by a chemist, but we have some hopes that the synthesis of sugar may one day be effected.

The Irrationale of Speech. By A Minute Philosopher. London: Longman and Co. 1864.

This is a reprint of a very clever article which appeared some years ago in *Fraser's Magazine.* It is written in undisguised advocacy of Dr. Hunt's method of curing stammering, but is none the less well worth reading. The writer appears to have benefited under the system, and we hope his words now flow as freely from his mouth as his thoughts from his pen, and in that case his conversation must be worth listening to.

The Ophthalmic Review, &c. Edited by J. Zachariah Laurence and Thomas Windsor. Hardwicke. No. 4. January, 1865.

The present number of this Review worthily sustains the reputation acquired by the earlier numbers. It contains papers by Graefe, Liebreich, and Dr. Mackenzie, and the first part of a long and able review, or abstract it may be called, of Donders' great book "On the Anomalies of Accommodation and Refraction," together with several practical articles of much interest to advanced ophthalmologists.

Annalen der Chemie und der Pharmacie. December, 1864.

This journal reaches us very late, which is not of much importance, since we have met before with nearly all the articles it contains. Among the novelties we notice a paper by Wehrhane and Hübner on "*Cyanide of Phosphorus.*" They prepare this body by heating together in a sealed tube a mixture of cyanide of silver and chloride of phosphorus. The mixture must be made in a strong tube, which is kept well cooled; the addition of a little chloroform or ether delays the reaction. After the tube is sealed it is heated to 130° or 140° for six or eight hours, and the contents are then distilled in a stream of dry carbonic acid. Long needles and thick tabular crystals of cyanide of phosphorus condense in the neck, and when cold may be detached by the aid of a glass rod. The cyanide must be quite cold, otherwise it is apt to take fire in the air. An analysis showed the composition to be $3CN,P$. The crystals inflame when touched with a warm glass rod. In moist air they gradually decompose, with separation of phosphorus, phosphorous acid, and formation of cyanic acid. They are but little soluble in chloroform, ether, bisulphide of carbon, and chloride of phosphorus. In water they are decomposed into cyanic and phosphorous acids. Cyanide of phosphorus is also produced by the action of pentachloride of phosphorus on cyanide of silver. The authors also tried the reaction of chloride of phosphorus and sulphocyanide of silver, and the chlorides of antimony and arsenic on cyanide of silver, but obtained no definite results.

J. Schiel communicates "*A Curious Lecture Experiment.*" He places some peroxide of silver in a test-tube, draws it out in the middle, and seals it. He then places it in a stoppered bottle, which he fills with well dried chlorine, then shakes the bottle and breaks the test-tube. The chlorine immediately attacks the peroxide of silver, and in a few seconds the bottle is filled with colourless oxygen. When oxide of silver is used, the colour change does not take place so rapidly. Equivalent amounts of chlorine and the peroxide must be used. The peroxide is prepared by passing a stream of ozonised oxygen (from a Siemen's tube with a strong induction apparatus) over dried oxide of silver, which must be stirred occasionally with a platinum wire. The author expects to prepare hypochlorous oxide $Cl\Theta$ in a similar way by using two equivalents of chlorine to one of oxide of silver—

$$Cl_2 + Ag\Theta = AgCl + Cl\Theta.$$

Zeitschrift für Chemie, &c. Nos. 1 and 2, 1865.

In these two numbers the new editors have laid English and American journals under contribution, and as yet we see no signs of the improvements and extensions promised by Dr. Hübner. Acrolein seems to be a body much studied in Germany, for we have here two papers, one by Genther, "*On the Chlorinated Derivatives of Acrolein,*" and another by Dr. Aronstein, "*On some Compounds from Acrolein.*" The latter has studied the action of alcoholate of potassium and sodium on chloride of acrolein, of bromine and chlorine on acrolein, and has decided that cyanogen has no action beyond resinifying the acrolein after long passing. He has also studied the behaviour of acrolein towards the chlorides of acetyl and benzoyl. An abstract of an inaugural dissertation by Karl Birnbaum gives an account of some *bromine compounds of iridium.* Bromide of iridium may be found by passing the vapour of bromine over iridium heated to redness, either alone or mixed with bromide of sodium; it is a blue compound. The author also describes some double bromides of iridium, and the alkaline metals, and ammonia. All the other papers of interest in the two journals have been noticed before.

NOTICES OF PATENTS.

1452. *Calcining and Smelting Copper Ores.* P. and J. B. Spence, Newton Heath. Dated June 11, 1864.

1506. *Smelting Copper Ore.* P. Spence, Smedley New Hall, and H. D. Pochin, Broughton Old Hall, near Manchester. Dated June 17, 1864.

These patents refer to improved modes of conducting the calcination and smelting of sulphuretted copper ores, whereby the sulphur is economised and the process of reduction effected with a considerable saving of fuel. The calciner instead of being placed independently of the smelting furnace, is connected with it, and the ore is first submitted to the action of heat in a part of the apparatus which may be described as being a prolongation of the flue of the smelting furnace; when the operation of roasting is completed, the ore is raked forward to the smelting hearth, and there mixed with the aluminous flux which forms the subject of the second patent. The sulphurous acid vapours which escape throughout the operation are conducted into a leaden chamber, and are there converted into sulphuric acid. The flux is described as being the insoluble residuum remaining after the action of sulphuric acid upon the shale of the coal measures used in the manufacture of alum.

1435. *Welding Steel and Cast or Malleable Iron.* C. W. Corsan, Sheffield. Dated June 9, 1864. (Not proceeded with.)

The inventor employs in the welding process, instead of sand alone, a mixture composed of borax fifty parts, Calais sand thirty parts, manganese and emery, of each ten parts.

1453. *Treating Mixed Fabric Rags containing Vegetable and Animal Fibre.* G. Rydill, Dewsbury. Dated June 11, 1864. (Not proceeded with.)

In separating cotton and woollen fibres when contained in a variety of white and coloured mixed fabrics, or rags of the same, the inventor acts upon the materials with nitric acid, or the same diluted with water, by which the cotton is destroyed, and the black or other dye upon the woollen fibres at the same time discharged.

1498. *Manufacture and Utilisation of Carbonic Acid.* G. H. Ozouf, Paris. Dated June 16, 1864.

The patentee describes a variety of processes which are applicable to the manufacture of the carbonates, and in the preparation of effervescing wines and aqueous beverages.

1509. *Manufacture of Leys or Liquors Applicable to the Cleansing and Bleaching of Wool, &c.* J. H. Johnson, Lincoln's Inn Fields, London. A communication. Dated June 17, 1864.

For the cleansing and bleaching of silk, wool, cotton, and other fibrous substances, as well as of textile fabrics, the inventor employs an alkaline ley or solution of sulphide of sodium in combination with the carbonate and silicate of soda, or the first-named agent in admixture with aluminate of potash or soda, or other alkaline salts possessed of detergent properties.

The use of alkaline sulphides for these purposes commonly imparts a dark colour to vegetable and animal fibres, on account of their containing appreciable traces of oxide of iron. An after treatment with dilute acid, or even prolonged exposure to air, would greatly improve the appearance of the goods, by dissolving out or inducing the oxidation of the ferrous sulphide.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

297. T. Routledge, Sunderland, "Improvements in treating spent or used leys resulting from the preparation of fibrous substances used in the manufacture of paper stock."—Petition recorded Feb. 2, 1865.

301. B. L. Moseley, Sheffield, "A new or improved tooth powder."—Feb. 3, 1865.

306. J. R. Webb, Hibernia Chambers, London Bridge, "A new or improved method, or process and apparatus, for obtaining the concentrated extract of hops, and for preserving the same from deterioration." A communication from G. Percy and others, New York, N.S.A.

307. F. Row, Colchester, Essex, "Improvements in the manufacture of citric and tartaric acids, and in the manufacture and treatment of citrate and tartrate of lime and analogous basic compounds, and in apparatus employed therefor."

310. J. A. Phillips, Earl's Court Terrace, Kensington, Middlesex, "Improvements in the purification of lead to be employed for the manufacture of white lead, red lead, and litharge."

311. F. C. Hills, Deptford, Kent, "Improvements in effecting the combustion of fuel in the furnaces of steam-

boilers, and the fire-places of stoves and of gas in gas burners, and in apparatus connected therewith."

313. Edouard Hottin, Rue de la Fidélité, Paris, "Certain improvements in rendering uninflammable cotton, silk, and other textile fabrics."

315. R. A. Brooman, Fleet Street, London, "An improved varnish for preserving wood, and for protecting iron ships and other metal work from oxidation and from fouling." A communication from A. Guibert, Paris.

319. R. M. Alloway, Strand, Middlesex, "Improvements in treating or manufacturing peat for fuel, and in apparatus for the same."—Feb. 4, 1865.

339. A. A. Hulot, Imperial Mint, Paris, "A new typographic ink."—Feb. 6, 1865.

340. J. Cornes, Ilford, Essex, and W. Simpson, Rosherville, Kent, "Improved machinery for cutting, sifting, separating, bruising, sacking, and preparing straw and other vegetable fibrous substances to be employed in the manufacture of various kinds of paper, and also for preparing food for cattle."—Feb. 7, 1865.

353. R. C. Thorp and P. Young, Barnsley, Yorkshire, "Improvements in the miner's safety lamp."

354. J. Desmoutils, Avenue de la Mothe Piquet, Paris, "Improvements in the manufacture of grease for lubricating purposes."—Feb. 8, 1865.

362. W. A. Marshall, Leadenhall Street, London, "A new or improved insulating material for telegraphic and other purposes, together with an improvement in protecting telegraph wires, especially applicable to submarine and subterranean telegraphs." A communication from J. Erckmann, Paris.

363. J. C. C. Halkett, Cramond Iron Works, Mid Lothian, N.B., "Improvements in protecting wooden surfaces from the fouling and injury to which they are ordinarily liable in sea water."

371. J. Dale, Manchester, "Improvements in the production of substances to be used in place of the pigment usually termed satin white."—Feb. 9, 1865.

374. E. Leigh, Manchester, "Improvements in furnaces for smelting iron ores, commonly called blast furnaces, also in cupolas used in foundries for rendering down or melting iron or other metals."—Feb. 10, 1865.

388. J. Hall, Nottingham, "The manufacture or production of oil for the use of machinery, or for other similar purposes."

391. W. Crookes, F.R.S., Wine Office Court, Fleet Street, London, "Improvements in extracting and separating gold and silver from their ores or matrices."

397. H. H. Grierson and J. M. Rigby, Manchester, "Improvements in cupolas and blast furnaces."—Feb. 11, 1865.

402. L. H. G. Ehrhardt, Richmond Road, Bayswater, "An improved gunpowder."

403. J. A. Pastorelli, Rue Cariol, Marseilles, "Improvements in extracting turpentine and tar from resinous wood."—Feb. 13, 1865.

411. H. J. Walduck and E. Barton, Manchester, "Improvements in furnaces for smelting or reducing ores, and for melting metals."

418. A. Fryer, Manchester, "Improvements in the mode of treating for evaporating and concentrating purposes cane juice, and saccharine and other solutions and liquids, and also in machinery or apparatus for the concentration of cane juice, and saccharine and other solutions, and for the evaporation of liquids."

419. E. H. Newby, Cheapside, London, "Improvements in the manufacture of cast and wrought iron."—A communication from A. L. Fleury, New York, U.S.A.—Feb. 14, 1865.

NOTICES TO PROCEED.

2533. W. R. Sykes, Pimlico, Middlesex, "Improvements in apparatus for transmitting positive and negative currents of electricity."

2538. R. Wright, Barge-yard, Bucklersbury, London, "Improvements in preparing saccharine matters."—Petitions recorded Oct. 14, 1864.

2560. J. Cassell, La Belle Sauvage Yard, London, "Improvements in apparatus for the combustion of gas and atmospheric air." A communication from J. Best, Paris. —Oct. 17, 1864.

2607. A. Reynolds, Bagillt, Flintshire, "An improved mode of manufacturing sulphuric acid."—Oct. 21, 1864.

2656. P. A. Le Comte de Fontaine Moreau, Paris, "An improved composition for uniting iron with wood, and leather with leather; for waterproofing textile fabrics, paper, and cordage; for moulding and for various other purposes." A communication from Lemaistre and Co., Brussels."—Oct. 26, 1864.

2786. W. E. Newton, Chancery Lane, "An improved filter or press." A communication from L. P. R. de Massy and L. R. de Massy, Paris.—Nov. 9, 1864.

2842. M. Henry, Fleet Street, London, "Improvements in the means of or appliances for treating bodily injuries, affections, and disorders when atmospheric air is to be excluded from the part affected." A communication from Dr. J. Guerin, Paris.—Nov. 14, 1864.

2896. J. Easton, jun., Southwark, "Improved apparatus for the manufacture of paper pulp."—Partly a communication from F. Thiry, Huy, Belgium.—Nov. 19, 1864.

2906. A. V. Newton, Chancery Lane, "Improvements in the manufacture of sugar, and in the machinery to be used therein."—A communication from C. Rosland, Paris. —Nov. 23, 1864.

16. T. J. Ashton, Cavendish Square, "An improved portable pneumatic apparatus, applicable in surgery and medicine for all purposes, as a douche for affusion, irrigation, injection, and for enemas."—Jan. 3, 1865.

93. A. G. Loek, Millbrook, Hampshire, "Improvements in extracting and purifying fats and other products from bones and other animal substances, and in apparatus for the same."—Jan. 11, 1865.

156. S. F. Van Choate, New York, U.S.A., "An improved system and apparatus for facilitating the working of submarine cables and other conductors of electricity." —Jan. 19, 1865.

209. W. Woodward, R. Woodward, J. Woodward, and A. Woodward, Manchester, "Improvements in furnaces for melting metals and smelting ores."—Jan. 24, 1865.

CORRESPONDENCE.

Continental Science.

PARIS, February 28.

MANY in England will learn with regret the news of the sudden decease of M. Gratiolet, the Professor of Zoology at the Sorbonne. He was seized with apoplexy on the 21st, and died in a few hours. As one of our most eloquent lecturers, and as an indefatigable worker, and an original thinker, his loss will be greatly regretted.

We have in the *Moniteur Scientifique* the announcement of a grand chemical school which Signor Cassola has opened at Naples. He has hired a large convent and turned it into a laboratory. Italy did much for alchemy, the great grandfather of chemistry, and monasteries were the homes of science in the middle ages. Let us hope then that Signor Cassola's establishment will flourish and produce abundant fruits.

M. Tellier is still busy with his ammoniacal horses. I am not aware that he has actually started one yet, but he has started a new idea. He thinks ammonia is the very thing to drive a carriage either over or through Mount Cenis. If you go through the mountain there will be no combustion to contaminate the air in that dreadfully long tunnel. If you go over, you may adapt the motive machinery to every carriage, or indeed to every pair of wheels, and thus multiply the points of contact so that there will be no difficulty in getting up the steepest ascents. And when you get to the top you have only to turn a tap, put on your break, and you may descend as slowly as you please. All this looks so simple that I am very anxious to see one of M. Tellier's vehicles started.

An icicle is an exceedingly pretty object, and it is a great pity that it only to be seen under circumstances of personal discomfort. The sight of one in summer would be very refreshing. In the absence of reality, a good imitation is worth looking at; but most imitations are execrably bad, mere conical impositions, which it is easy to see that Nature had no hand in making. So, I suppose, thought M. Millot-Brulé as he looked one frosty morning lately at some beautiful objects which hung from a weir; and he carefully broke them off, took plaster of Paris moulds of them, and now makes casts which he says form beautiful ornaments for aquaria, fish basins, and other objects.

M. Jules Faure mentions a scientific curiosity, which I am inclined to think new. If, he says, you put a crystal of sulphate of copper or sulphate of iron into a very dilute solution of silicate of potash, a sort of mineral vegetation grows up of the same colour as the sulphate. You may, in fact, obtain a miniature forest at the bottom of a jar, and by placing the crystal on the top of a layer of well-washed sand coloured with a little bichromate of potash, you may appear to have an artificial soil greatly resembling a natural gravelly deposit. The misfortune is that you cannot move the vessel, for a slight shake will destroy all the beauty of the appearance.

M. Lallemand, of Versailles, has found that the light of magnesium is sufficiently active to determine the combination of hydrogen and chlorine. He effects the explosion with the light from a single wire burnt in a spirit lamp.

An ingenious clockmaker of Versailles has invented a clock, no larger than the ordinary instruments, which will go for a year, or indeed for a much longer time. The internal mechanism is not altered, but the pendulum is replaced by a horizontal lever, which acts on a twist of elastic wire suspended vertically.

M. Liandier has been a diligent observer of shooting stars for the last three years, and he asserts without fear of contradiction that all meteors which leave no trail are going in the same direction as the atmospheric wave in the upper regions of the air, while those which do leave a trail are going in an opposite direction.

The French Government has tried Dr. Morgan's method of preserving entire sheep and oxen, and the results of the experiments have been highly satisfactory. The animals killed and injected last August have been eaten recently, and the meat was found to be excellent—especially the beef-steaks, say the reporters. I should hope this process will soon be in use in South America; I know it will be in Australia. The South American Beef Company should look to it.

You will have heard, probably, that the French Government has laid a tax on telegraphic dispatches. Caselli's autographic apparatus is in use, and the tax is laid on the surface of paper employed, 20 centimes per square centimetre. This would be an awful tax in England, where people usually write a much larger hand than they do here. The Administration sells sheets of paper of different dimensions, 30, 60, 90, and 120 square centimetres for the dispatch to be written upon, but they charge 10 centimes for all sizes.

The journals here made a mistake which I copied some time ago when making mention of a mechanical leech, invented by Dr. Damoiseau. It was said that this instrument would extract 60 grammes of blood a minute, but the Doctor now writes to say that it will draw as much as 120 grammes in that time, which is equal to the result obtained by 600 *leeches sucking at once.* That would be terrible; the instrument is named *a térabdelle.*

We have had a long patent trial here. It began in 1859, and the matter in dispute was a patent for "lichen dyes" (French purple), which was taken out by M. Frezon on August 14, 1848, and who had brought an action against MM. Guinon and Marnas for infringement. The Court decided against the patentee on the ground that Dr. Stenhouse's paper communicated to the Royal Society on February 3, 1848, was a previous publication of a process substantially the same, and producing the same result, and therefore M. Frezon's patent was invalid.

I think I have before mentioned a method of preserving bodies devised by Signor Gorini. The Academy of Sciences of Turin have given the method a trial, and report it satisfactory. A body is preserved fresh in a fit state for dissection for six months or more. It gradually hardens, however, and becomes a sort of mummy, which resists decay for an indefinite period of time, but which can again be made soft and supple by soaking in water. After this discovery there need never be a lack of subjects in our dissecting-rooms. In times of plenty we may preserve and bury the bodies, and take them up again as wanted.

On a Phenomenon occasionally observed in the Determination of Moisture.

To the Editor of the Chemical News.

Sir,—In the determination of moisture for commercial purposes it is frequently the custom, previously to weighing the dried substance, to place the watch glass containing it in contact with the hand, in order to ascertain whether it has completely cooled. In so doing a considerable electrical excitement will be occasionally observed among the particles on the watch glass, sometimes of sufficient violence to cause them to be projected from its surface, and thus to render the determination worthless. This phenomenon, which is not very visible with most substances, is best seen in light bodies in a state of fine division—powdered animal charcoal, for instance, and is probably owing to the fact that, however carefully we apply the hand to the bottom of the watch glass, it is almost impossible to avoid a certain amount of friction and the consequent electrical excitement. It need scarcely be said that by actually rubbing the hand beneath the watch glass a very considerable portion of its contents may be thrown out, and also that the excitement (in which, except for its appearance under the peculiar circumstances above detailed, there is, of course, nothing remarkable) decreases rapidly by a brief exposure to a moist atmosphere.

I have now observed this phenomenon from time to time for at least seven years, and if the contents of this note should appear to you to possess any novelty, I would feel obliged by its being published in your valuable journal. I am, &c.

John A. R. Newlands, F.C.S.

Laboratory, 19, Great St. Helens, E.C., Feb. 27.

MISCELLANEOUS.

Royal Institution.—The following are the arrangements for the ensuing week:—Monday, March 6, at 2 o'clock, General Monthly Meeting; at 3 o'clock, Professor Tyndall, "On Electricity." Tuesday and Thursday, March 7 and 9, at 3 o'clock, Professor Hofmann, F.R.S., "An Introduction to Chemistry." Friday, March 10, at 8 o'clock, Professor Ramsay, F.R.S., "On the Eozoon," (or earliest known fossil). Saturday, March 11, at 3 o'clock, Professor Marshall, F.R.S., "On the Nervous System."

Wholesale and Export Drug Company (Limited).—The directors announce that they are enabled to close the share list of this Company for allotment or shares, for London on Saturday, March 11, and for the country on Monday, March 13. They also state that the warehouse and business arrangements of the Company will be placed under the management of Mr. William Charity, who has held a similar position for the last fourteen years with the eminent firm of Messrs. Barron, Harveys, and Co., wholesale druggists.

"Our Inheritance in the Great Pyramid."—In the concluding paragraph of our notice of this work it was stated that Professor C. P. Smyth was about to proceed to Egypt to ascertain for himself the accuracy of certain measurements relating to the Great Pyramid of Jizeh, and we further informed our readers of the author's intention of testing the employment of the magnesium light as a means of illuminating the interior, and photographing the most interesting features of this wonderful monument of ancient art.* We have now the satisfaction of announcing the safe arrival of Professor Smyth and his party, and of reporting the progress made by him during the first three weeks of his residence. Mr. Spiller has favoured us with the following extract from a letter which he has lately received from Professor Smyth:—

"East Tomb, Great Pyramid, Feb. 2, 1865.

"My dear Sir,—We are settled down at last to the measuring; the chief part of the time hitherto (about three weeks) having been occupied in concert with a party of labourers furnished by the Egyptian Government in clearing away rubbish from important parts of the interior, and in cleansing and preparing it for nice observation.

"The magnesium wire light is something astounding in its power of illuminating difficult places. With any number of wax candles which we have yet taken into either the king's chamber or the grand gallery, the impression left on the mind is merely seeing the candles and whatever is very close to them, so that you have small idea whether you are in a palace or a cottage; but burn a triple strand of magnesium wire, and in a moment you see the whole apartment and appreciate the grandeur of its size and the beauty of its proportions. This effect, so admirably complete, too, as it is, and perfect in its way, probably results from the extraordinary intensity of the light, apart from its useful photographic property; for side by side with the magnesium light the wax candle flame looked not much brighter than the red granite of the walls of the room. There come parties—often many parties—of visitors to see the Pyramid every day, and they come amply provided, too, with all sorts of means and appliances to enjoy the sight—*i.e.*, with everything but the needful magnesium wire; and one waistcoat pocket full of that would be worth a whole donkey load of what they do bring up to enable their souls to realise the ancient glories of the internal scene.

"Whatever can be reached by hand is chipped, and hammered, and fractured to a frightful degree; and this maltreatment by modern man, combined with the natural wear and tear of some of the softer stones under so huge a pressure as they are exposed to, and for so long duration, has made the measuring of what *is* excessively tedious and difficult, and the concluding what *was*, in some cases, rather ambiguous. The temperature, of which I am glad to find you like the idea, is one of these, and I am accumulating observations upon it as it is and on the anomalous conditions accompanying.

"I remain yours very truly,
"C. Piazzi Smyth.

"John Spiller, Esq., Chemical Department,
Royal Arsenal, Woolwich."

The Use of Sewage.—Baron Liebig has addressed another letter to the Lord Mayor in strong condemnation of Messrs. Hope and Napier's Maplin Sands' scheme. "The project of Messrs. Napier and Hope," he says, "is one of the most curious. It is, in the fullest sense of the word, baseless, for the land to be experimented upon does not as yet exist. All the calculations, therefore, as to crops, returns, and percentage of capital are absolutely fabulous. It seems to me like a soap-bubble, glistening with bright colours, but inside hollow and empty; there is not the slightest doubt that every penny expended upon that frivolous undertaking would be irretrievably lost. The carrying out of this scheme would not only be a squandering of an enormous amount of money, but before long would also be looked on as a national calamity." The Baron argues the impossibility of making sand fertile, and appears to us to take into too little account the undissolved ingredients of London sewage.

Homicide by Imprudence.—That is a verdict which brought a fine of 50 francs and eight days' imprisonment upon Madame Roy, who deals in drugs and groceries, and in the course of her business sold 50 grammes of nitre in mistake for seidlitz powder, and so caused the death of Madame Helie. It is a curious feature in the French law that a grocer may sell drugs, but not in medicinal doses, a regulation which seems to afford no protection to life..

Liquor Potassæ as a Solvent for Gum Resins.—Solutions of gum resins in liq. potassæ recommend themselves for their elegance and economy, while they are generally very effective. For instance, a dilute solution of ammoniacum in water is perfectly clear, whereas a tincture produces an opaque mixture. The alkaline solutions of aloes, catechu, and kino are very cheap and elegant colouring matters, a few drops giving a deep tint to half a pint of water. The quantity of liq. potassæ best adapted for each gum resin will be found to be as follows:—

Aloes . . .	1	part to	15	liq. potassæ.
Ammoniacum .	1	,,	4	,,
Assafœtida . .	1	,,	10	,,
Catechu . .	1	,,	10	,,
Guaiacum . .	1	,,	7	,,
Myrrh. . .	1	,,	5	,,
Opium . .	1	,,	10	,,

—*Year Book of Pharmacy.*

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. *Private* letters for the Editor must be so marked.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

J. W. will see that the error was corrected last week.

B. was answered last week under the initial "C."

F.—Yes; all are liable.

W. J. Morgan.—Mr. Baillière, Regent Street, will give you the information.

P. W.—Pure zinc for the purpose can be obtained at most operative chemists.

A Long Subscriber.—Oil is most easily extracted from engineer's waste, &c., by means of sulphide of carbon, which can be distilled from the oil without much loss and used again.

The Superior of St. Joseph's.—We have not been able to find a description of Clark's polarising apparatus. Faraday, "On the Non-metallic Elements," was published by Longman and Co. If the publishers should not have a copy, the book may often be met with second-hand.

Self-taught.—1. Most works on chemistry contain tables of French weights and measures, with their English equivalents, and by the help of these, and knowing the specific gravity, you can arrive at the desired results by a rule-of-three sum. 2. We do not see what our correspondent wishes to know. The calculations quoted appear to be correct.

Books Received.—"Zeitschrift für Chemie;" received regularly from the Editor. "Richardson and Watts' Chemical Technology;" new volume; Baillière. "For and Against Tobacco," by Dr. B. W. Richardson; Churchill and Sons. "The Spirit of Nursing," by Harry Jones, M.A.; Hardwicke.

Received.—J. S. Blockey.

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* *Vide* Chemical News, vol. x., p. 296.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

An Introduction to Chemical Philosophy, according to the Modern Theories, by ADOLPHE WURTZ, *F.R.S.*

PART I.

EQUIVALENTS, ATOMIC WEIGHTS AND MOLECULAR WEIGHTS.

SECTION I.—*Historical Development of the Ideas, Equivalent, Atom, Molecule.*

(Continued from page 100.)

Law of Specific Heats.—Dulong and Petit have shown that the specific heat of simple bodies is in inverse ratio to their atomic weights, in such a manner that if the two quantities are multiplied together the product is constant.

This is equivalent to saying that the atoms of simple bodies, so different from each other in their relative weights, possess evidently the same specific heat. This is an unexpected result, which may be regarded as a striking confirmation of the atomic hypothesis:—

The following are the results obtained by Dulong and Petit:—

Simple bodies.	Specific heat.	Atomic weight.	Product of atomic weights by the specific heat.
Sulphur . .	0·1880	201·15	0·3790
Gold . .	0·0298	1243·0	0·3704
Platinum .	0·0314	1215·2	0·3816
Tin . .	0·0514	735·3	0·3779
Bismuth .	0·0288	1330·4	0·3835
Copper . .	0·0949	395·7	0·3755
Lead . .	0·0293	1294·5	0·3793
Zinc . .	0·0927	403·2	0·3738
Nickel . .	0·1035	369·7	0·3826
Iron . .	0·1100	339·2	0·3731

Some few exceptions to the law of specific heats have been observed. Among the simple bodies experimented on by Dulong and Petit, arsenic, antimony, silver, tellurium, and cobalt have not shown this remarkable relation between the atomic weights and the specific heats. But these exceptions may be attributed, on the one part, to our ignorance of the real atomic weights, and on the other to errors in the determination of the specific heat—errors which the classical researches of M. Regnault have since entirely overcome. We will return to this subject.

In order to appreciate the assistance rendered at that time by the law of specific heat to the atomic theory, it is enough to remark that in the case of copper and of some other metals it has helped to make the true series of oxidation of these metals known, and to decide in favour of the atomic weights which have been generally adopted.* Thus the atomic weight of copper compared with that of oxygen (100) is not 791·4, but 395·7, a number which agrees with the law of specific heats.

Isomorphism.—The grand discovery of Mitscherlich has rendered similar service. It may be thus explained. Bodies composed of an equal number of atoms arranged in the same manner crystallise in forms identical, or almost so. The resemblance of the exterior forms results from the similitude of their atomic structure; and isomorphous bodies offer this remarkable peculiarity, that they can mix in indefinite proportions in the crystals without the form being sensibly changed.

But it is a necessary consequence of this law that whenever two bodies are really isomorphous they possess similar atomic structure. Their composition ought then to be expressed by analogous formulæ. Sulphate of copper and sulphate of iron can mix when crystallised together, and the form of these crystals remains that of sulphate of iron whenever the proportion of sulphate of copper is less than $\frac{18}{20}$. These mixed crystals contain seven molecules of water, like crystals of green vitriol. If, on the contrary, the proportion of sulphate of copper exceeds $\frac{18}{20}$, the mixed salt takes the form of blue vitriol (unsymmetrical prisms), and like it contains five molecules of water. These two vitriols, which can crystallise together, must then possess the same atomic structure, and if green vitriol contains one atom of iron, blue vitriol ought to contain one atom of copper. It follows, therefore, that oxide of iron and oxide of copper each contain one atom of metal and one atom of oxygen, and we must take for the atomic weight of copper the quantity of this metal which combines with one atom of oxygen (100 of oxygen) to form the second oxide of copper—that is to say, cupric oxide.

Isomorphism and the law of specific heats agree, then, in the adoption for this oxide of the formula CuO, a fact which fixes the atomic weight of copper. We know, on the other hand, that the two oxides in question are isomorphous with the protoxides of nickel, cobalt, and manganese, oxide of zinc, and magnesia. All those oxides possess the same atomic composition. The following is another example:—Iron alum and ordinary alum will crystallise together, and whatever be the proportions of the mixture the form of the crystals is always that of a regular octahedron. The double sulphate of alumina and potash is thus isomorphous with the sulphate of iron and potash. The two sulphates and the two oxides should therefore possess the same atomic composition, and if ferric oxide contains two atoms of iron and three atoms of oxygen, alumina must be composed of two atoms of aluminium and three atoms of oxygen.

Such is the assistance that the law of isomorphism affords in the construction of formulæ and the determination of atomic weights.

Equivalent Notation.—The discoveries of Gay-Lussac, of Dulong and Petit, and of Mitscherlich proved to be a strong confirmation of Dalton's ideas, and the enormous labours of Berzelius had given a solid basis to them. For twenty years the system of atomic weights and notation of the great Swedish chemist were paramount in science, owing to the legitimate and incontestable authority of his name. Nevertheless, some objections were raised against this notation, and the idea of double atoms met with a certain amount of opposition. Why should we admit, said Gmelin,† that the equivalents of hydrogen, chlorine, bromine, nitrogen, &c., are formed of double atoms, when the simple atoms of these bodies do not in reality exist in any combination? An atom is the smallest quantity of a body which enters into combination. The equivalents of the preceding bodies represent, therefore, their atoms, and it will be much better to take for their atomic weights numbers double those which Berzelius has given in conformity with the theory of volumes. The formulæ of water, of hydrochloric acid, and of ammonia, become therefore HO, HCl, NH_3.

To raise these objections was to revive afresh the ideas of Dalton and Wollaston; it was in reality making a step backward, for no importance was attached to the discoveries of Gay-Lussac, and, in consequence, this nota-

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* Berzelius, *Traité de Chimie*, French edition of 1831, iv., 601 (see also the note in CHEM. NEWS, p. 100).

† *Handbuch der Chemie.* Fourth edition, I. 47.

tion by equivalents which was thus inaugurated, finished by acquiring, during the years 1843-1844, the unanimous assent of chemists. The idea of atoms, said they, and atomic notation, are undoubtedly based upon an hypothesis; equivalents represent a reality. Equivalent notation is, therefore, preferable, as it only involves facts.

It was in this manner that the objections raised against the idea of double atoms, which constituted, in fact, the weak part of Berzelius' doctrine, were the cause of the abandonment of atomic notation and the adoption of equivalent notation—a system which is even now employed by many chemists. The equivalents which form the basis of this latter notation are, with few exceptions, those given in the fifth column of the table on page 99, with the exception that it is now considered more convenient to compare them with hydrogen taken as unity.

The following is the table, so modified :—

Table of the Equivalents of Simple Bodies.

Aluminium	13·7
Antimony	122
Arsenic	75
Barium	68·5
Bismuth	210
Boron	10·9
Bromine	80
Cadmium	56
Calcium	20
Carbon	6
Cerium	46
Cæsium	130
Chlorine	35·5
Chromium	26·7
Cobalt	29·5
Copper	31·7
Didymium	48
Fluorine	19
Gold	197
Glucinum[‡]	4·7
Hydrogen	1
Iodine	127
Iridium	99
Iron	28
Lanthanum	46·4
Lead	103·5
Lithium	7
Magnesium	12
Manganese	27·5
Mercury	100
Molybdenum	48
Nickel	29·5
Niobium	48·8
Nitrogen	14
Osmium	99·6
Oxygen	8
Palladium	53·3
Phosphorus	31
Platinum	98·7
Potassium	39·1
Rhodium	32·2
Rubidium	85·4
Ruthenium	52·2
Selenium	39·7
Silicium[§]	14
Silver	108
Sodium	23
Sulphur	16
Strontium	43·8
Tantalum[‖]	68·8
Tellurium	64
Thallium	204
Thorium[¶]	59·6
Tin	59
Titanium	25
Tungsten	92
Uranium	60
Vanadium	68·6
Yttrium	?
Zinc	32·6
Zirconium[**]	44·8

It should be remarked that this notation was never applied in a very rigorous manner; and, moreover, the progress of science soon rendered it insufficient, and involved chemists who persevered in its employment in singular inconsistencies.

In the first place, let us observe that the composition of the poly-acid bases, such as alumina or ferric oxide, has almost always been expressed by molecular formulæ and not by equivalent formulæ. It was known that one molecule of alumina would saturate three molecules of sulphuric acid, and this quantity of alumina was wrongly termed an equivalent of alumina. The true equivalent of alumina—that is to say, the quantity of alumina which corresponds to one molecule of potash or of oxide of silver—is the quantity of alumina which contains an equivalent of oxygen. It is this quantity which saturates an equivalent of sulphuric acid. In the notation of equivalents the alumina ought, then, to be represented by the formula $Al_{\frac{2}{3}}OSO_3$, or $SAl_{\frac{2}{3}}O_4$. Thus wrote Gay-Lussac.[††] The general formula used, $Al_2O_3 3SO_3$, did not express an equivalent of sulphate of alumina, but a molecule of sulphate of alumina.

Analogous remarks apply to the poly-basic acids discovered by Mr. Graham, which have clearly defined the notion of poly-atomic molecules. Mr. Graham has shown that common phosphoric acid will saturate three equivalents of a base RO. From that it is evident that one molecule of phosphoric acid saturating three equivalents of oxide of silver cannot correspond to one molecule of acetic acid which only saturates one. The equivalent of phosphoric acid is the quantity of this acid which saturates one equivalent of oxide of silver, and its equivalent formula is therefore $\frac{1}{3}PO_5$. Gay-Lussac, with that rigid accuracy characteristic of his mind, employed such formulæ.

Moreover, Richter was not deceived by this, and the number given in his tables well represents the quantity of this acid which saturates one equivalent of soda in bi-sodic phosphate. (See the note on page 49.)

Should we, then, say that this equivalent notation adopted by Gay-Lussac is preferable to the molecular notation employed by other chemists less scrupulous than he? This must be answered in the affirmative if chemical formulæ only serve to represent equivalents between bodies. But it is not so. Their language is higher and more significant. They are employed to show the complication of molecules, and when they are made use of to depict a reaction, they ought to represent both the bodies which enter and those which are removed—to show, in short, their molecular movements. Equivalent notation is of no use in this respect. It hides very important points in reactions or in the constitution of bodies. When it represents sulphate of alumina by the formula $Al_{\frac{2}{3}}OSO_3$, it does not express the polyacid character of alumina; when it represents phosphate of silver by the formula $AgO\frac{1}{3}PO_5$, it hides the tribasic nature of phosphoric acid. This is why chemists have instinctively preferred molecular notation to equivalent notation for the salts in question.

It is seen from the above that, after having pointed out a difference between atoms and equivalents, the progress of science leads to the separation of the idea of molecule from that of equivalent of a compound body. Molecules, in fact, are not always equivalent among each other. One molecule of phosphoric acid is not the equivalent of one molecule of acetic acid, and one molecule of alumina is not equivalent to one molecule of oxide of silver.

The distinctions here spoken of were not established in a day. They are ideas which long fermented in chemists' minds before they found expression. The merit of having clearly defined the words atom, equivalent, and molecule belongs principally to Gerhardt, whose researches we will now briefly explain.

(To be continued.)

On the Atomicity of Aluminium, by Professor A. W. WILLIAMSON, *F.R.S.*

In the "Preliminary Note on some Aluminium Compounds," by Messrs. Buckton and Odling,[*] some questions of considerable theoretical importance are raised in connexion with the anomalous vapour-densities of aluminium ethyle and aluminium methyle. The authors have

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[‡] Oxide of glucinum, GlO.
[§] Silicic acid, SiO_2.
[‖] Tantalic acid, TaO_2.
[¶] Thorina, ThO.
[**] Zirconia, ZrO_2.

[††] *Cours de Chimie*, 1828, 8e leçon, page 16.

[*] See ante, p. 61.

discovered that the vapour of aluminium methide (Al_2Me_6) occupies rather more than two volumes (H=1 vol.) at 163°, when examined by Gay-Lussac's process, under less than atmospheric pressure. The boiling-point of the compound under atmospheric pressure is given at 130°, and the compound accordingly boiled a good deal below 130° at the reduced pressure at which the determination was made. The vapour was, therefore, considerably superheated when found to occupy a little more than two volumes. When still further superheated up to 220° to 240°, it was found to possess a density equivalent to rather less than four volumes at the normal temperature and pressure.

The aluminium ethyle was found to have a density decidedly in excess of the formula $Al_2Et_6 = 4$ vols., but far too small for $Al_2Me_6 = 2$ vols. From their analogy to aluminic chloride, $Al_2Cl_6 = 2$ vols., the methide and ethide might be expected to have vapour-volumes corresponding to $Al_2Me_6 = 2$ vols., $Al_2Et_6 = 2$ vols. The authors seem, however, more inclined to doubt the truth of the general principles which lead us to consider these hexatomic formulæ the correct ones, than to doubt their own interpretation of the observations already made upon the new compounds.

Even if the vapour-volume of aluminic chloride had been unknown to us, there were ample grounds for assigning to aluminium methide a molecular formula Al_2Me_6 and a vapour-density corresponding to $Al_2Me_6 = 2$ vols.; for the close analogy of aluminic and ferric salts is perfectly notorious, and the constitution Fe_2O_3 for ferric oxide settles Al_2O_3 as the formula for alumina. With regard, however, to the chlorides of these metals, it might be supposed that the formula $FeCl_3$ and $AlCl_3$ would be the most probable molecular formulæ; and Dr. Odling, in his useful "Tables of Formulæ," published in 1864, expressed an opinion in favour of these formulæ by classing as anomalous Deville's vapour-densities, which correspond to the higher formulæ Al_2Cl_6, Fe_2Cl_6. It is well known that Laurent and Gerhardt, whose penetrating minds raised so many vital questions of chemical philosophy, laid down a preliminary rule that every molecule must contain an even sum of the atoms of chlorine, hydrogen, nitrogen, and metals. According to this rule, the formulæ Al_2Cl_6 and Fe_2Cl_6 would have no greater probability than the formulæ $FeCl_3$, $AlCl_3$; and judging by that rule, Dr. Odling naturally preferred the simpler formulæ.

Since Gerhardt's time chemists have, however, extended to the greater number of metals the arguments which proved oxygen to be biatomic; and we now know that the alkali-metals, the nitrogen series, silver, gold, and boron, may count with the atoms of chlorine, hydrogen, &c. to make up an even number in each molecule, but that the greater number of metals must not be so counted; for that in each molecule in which they are contained the sum of the atoms of chlorine, hydrogen, nitrogen, potassium, &c. must be even, just as much as if the atom of the diatomic or tetratomic metal were not in the compound. In a paper "On the Classification of the Elements in relation to their Atomicities," I had occasion to point out that inasmuch as iron and aluminium belong, partly by their own properties, partly by their analogies, to the class of metals which do not join with chlorine, &c., in making up an even number of atoms, the number of those other atoms in each molecule must be even in itself, just as if iron or aluminium were not there; and that accordingly the formulæ Fe_2Cl_6, Al_2Cl_6 are really quite normal. In like manner I showed that the vapour-density of calomel, $HgCl = 2$ vols., is anomalous, as containing in a molecular volume a single atom of chlorine, although, in accordance with Gerhardt's rule, Dr. Odling had classed it as normal. I certainly understood that my able friend accepted my suggestion in this case at least, for he speedily brought forward theoretical and experimental facts in confirmation of it.

These examples serve to show that it was to be expected that the ethyle and methyle compounds of aluminium would contain an even number of atoms of ethyle and methyle in each molecule, and that their formulæ would accordingly be Al_2Me_6, Al_2Et_6.

It remains for us to consider how the deviation from our theoretical anticipations in the case of aluminium ethyle and the partial deviation in the case of aluminium methyle ought to be treated.

Fortunately we have the benefit of some experience to guide us in this matter, for a considerable number of other compounds have been found to occupy in the state of vapour nearly double the volume which corresponds to one molecule; but, with very few exceptions, all of them have already been proved to have undergone decomposition, so as to consist of two uncombined molecules. Thus sal-ammoniac is admitted to have the molecular formula NH_4Cl; yet in the state of vapour this quantity occupies the volume of nearly two molecules—viz., four volumes. Has the anomaly led us to doubt the atomic weight of chlorine, nitrogen, or hydrogen, or to doubt any other of the results of our comparison of their compounds? Or has it led chemists to diffusion experiments with its vapour, proving it to contain uncombined HCl and NH_3, each occupying its own natural volume? Has it not been proved that at the temperature at which sal-ammoniac vapour was measured, its constituents mix either without evolving heat (that invariable function of chemical action), or, according to another experimentalist, with evolution of far less heat than of the whole quantity of hydrochloric acid and ammonia combined, on coming together at that high temperature?

Again, SO_4H_2 is known to represent the formula of one molecule of hydric sulphate, yet the vapour formed from it occupies nearly the bulk of two molecules. Has this fact cast any doubt on the atomic weights of the elements S, O, or H? Or has it led to the discovery of peculiarities in the constitution of the vapour which would probably have escaped notice had they not been anticipated by theory, peculiarities which go a long way towards bringing the apparent anomalies within the law?

Nitric peroxide, N_2O_4, was considered, from our knowledge of other volatile compounds of nitrogen, to be anomalous in its vapour-volume, being $N_2O_4 = 4$ vols.; and we have been shown by the experiment of Messrs. Playfair and Wanklyn, that the anomaly almost disappears when the compound is evaporated by the aid of a permanent gas at a temperature considerably below its boiling point, as its theoretical molecule N_2O_4 is then found to occupy the two volumes which every undecomposed molecule occupies. This explanation seems to me to be the more entitled to grave consideration on the part of the discoverers of the new aluminium compounds, from the fact that the evidence in favour of it has been admitted to be conclusive by Dr. Odling, who classes nitric peroxide by the formula $N_2O_4 = 2$ vols. among compounds with normal vapour-densities, in virtue of the fact that at low temperatures it can be obtained with that density, though having half that density at higher temperatures.

The arguments for admitting that the low vapour-densities of the aluminium compounds are anomalous are even stronger than those which are admitted in the case of nitric peroxide; for it did require very severe superheating to get the aluminium compounds to near four volumes, whereas it required very ingenious devices to get nitric peroxide out of the four-volume state.

Such guiding principles as we have acquired in chemistry are the noblest fruits of the accumulated labours of numberless patient experimentalists and thinkers; and when any new or old fact appears to be at variance with those principles, we either add to our knowledge by discovering new facts which remove the apparent inconsistency, or we put the case by for a while and frankly say that we do not understand it.

The decision of the atomic weight of aluminium has involved greater difficulty than was encountered in the case of most other metals, owing to the fact of our knowing only one oxide of the metal, and salts corresponding to it; but the analogies which connect aluminium with other metals are so close and so numerous, that there are probably few metals of which the position in our classification is more satisfactorily settled. We may safely trust that the able investigators who are examining these interesting compounds will bring them more fully than now within the laws which regulate the combining proportions of their constituent elements; for, as it now stands, the anomaly is far less than many others which have been satisfactorily explained by further investigations.

Meanwhile aluminium is a metal singular for only appearing in that pseudo-triatomic character in which iron and chromium appear in their sesquisalts.

TECHNICAL CHEMISTRY.

Analysis of the Seed of Phormium Tenax,

by Dr. A. Adriani.

The other day a seafaring man, master of an East Indiaman, gave me as a curiosity a small quantity of the seed and a few unopened—*ergo*, pods containing seed—of the plant well known in Europe as Phormium tenax, belonging to the natural family of the Liliaceæ, and yielding the so-called New Zealand flax. As my informant stated that this seed was, or had been, brought to Europe in small quantity to be tried as oil-yielding material, I felt induced to make an analysis of the seed and the pods, since by a first inspection I hardly believed the seed contained any oil at all. The seed is very light; as given me it was very dry, jet black, and exhibiting a lustre as if it were the broken pieces of the wing covers of some insects. The analysis of the seed gave the following results in 100 parts:—

Crushed Seed.

Water driven off at 212°	8·01
Oil extracted by ether	20·08
Resinous matter soluble in alcohol . .	3·80
Gum, mucilage, inuline-like starch, and a trace of legumin, soluble in boiling water	14·32
Albuminous compounds	18·28
Woody fibre	30·96
Ash	4·55
	100·00

The presence of a trace of an albuminous compound in the aqueous solution was detected by adding a drop of acetic acid and afterwards of a solution of ferrocyanide of potassium to the clear aqueous solution, a very light, flocculent precipitate making its appearance. There is no starch present in this seed of the kind which yields with iodine a blue colouration. The ash, the aqueous solution of which exhibited distinctly an alkaline reaction to red litmus paper, contains phosphoric, sulphuric, and silicic acids; further, chlorine, potassa, soda, lime, magnesia, and oxide of iron. The analysis of the pods freed from seed gave the following result:—

Water driven off at 212°	10·70
Waxy fat and a trace of tannic acid, soluble in ether	1·00
Resinous and colouring matter soluble in boiling alcohol	2·55
Gum, mucilage, sugar, and colouring matter soluble in boiling water	24·00
Albuminous compounds	6·92
Woody fibre	47·93
Ash	6·90
	100·00

The ash of the pods was, after having been treated with water, found to have a distinct alkaline reaction. The component elements were found to be the same as those already mentioned for the seed, but in the pods the quantity of phosphoric acid appears to be less. The testing was, however, simply qualitative. In Europe, at least in our latitude, the Phormium tenax, though, and this even rarely, yielding blossom, as far as I have been able to ascertain, does not yield fruit. The oil I obtained from a larger quantity of the seed by exhausting it by means of bisulphide of carbon was rather deep yellow coloured, but this is no doubt due to the fact that bisulphide of carbon, though an excellent solvent for oils, also extracts some resinous and colouring matter I think, and as oil-yielding material and as food for cattle the seed and pods of Phormium tenax deserve the attention of the inhabitants of New Zealand. The crushed seed has a pleasant smell, and in contact with warm water distinctly reminds me of the fragrance of the *Radix iridis florentinæ* (orris root). The weight of the seed per bushel is 14·952 avoirdupois pounds, this weight being deducted from the actual weighing of one half imperial pint full of seeds. As not many analyses exist of seeds belonging to this class, I thought the communication in your paper might be of interest to some of your readers. I am not aware whether the natives or Europeans settlers in New Zealand make any use of the seed and the pods of the Phormium tenax.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 2.

Professor A. W. Williamson, *Ph.D., F.R.S., President, in the Chair.*

The minutes of the last ordinary meeting were read and confirmed, and the donations to the Society's library duly acknowledged. Mr. Arthur Vacher was formally admitted a Fellow of the Society, and the names of the following candidates were proposed for the first time:—viz., Capel H. Berger, Esq., Lower Clapton; Alexander W. Gillman, Esq., Southfield, Wandsworth; Arthur S. Hobson, Esq., Turnham Green; George B. Robertson, Esq., Stamp Office, Somerset House, and Upper Holloway; Robert Barton, Esq., Bushy Park, Teddington; William Chrispin, Esq., Darlington, Durham; William Judd, Esq., Christchurch, Hants; and Michael Foster, jun., M.D., Huntingdon.

Dr. F. Crace Calvert favoured the Society with an interesting communication entitled "*On the Action of Silicate and Carbonate of Soda upon Cotton Fibre.*" These observations arose out of an inquiry into the cause of rottenness which made itself apparent in some white and blue-dyed goods which were shipped to South Africa about two years ago, and were returned to Manchester in consequence of the damage they had sustained. The question was referred to Dr. Calvert to determine, if possible, whether the shippers or the manufacturers were at fault, and the evidence fixed the responsibility upon the latter. Upon opening the bales, the pieces which first came to hand were found to be discoloured, but otherwise retained their original strength and soundness; below these few pieces, and all in the interior of the bales within an inch of the wrappers, were found to be perfectly rotten. Some of the pieces (exhibited) happened to be packed in such a position that their folded edges were in contact with the wrappers, and these parts only remained sound. It was noticed that the oiled cloth or waterproof calico used for packing had become resined by oxidation (according to the principle which, in connection with india-rubber and gutta-percha, had been described by Mr. Spiller at the last meeting), and as a consequence of this change in the nature of the oily material, the bales were no longer protected from the action of water, which entered and left its mark upon the paper lining and flax wrappers immediately inside the oil-cloth packing. In seeking for the cause of deterioration, the author soon ascertained that the goods had not been finished by the old starch dressing, but had been treated according to a more modern process with a solution of silicate of soda. Dr. Calvert then found an indication of liberated alkali in the paper and wrappers, which seemed to point, on the other hand, to the fixation of silica by the fabric. The amounts of silica and alkali were then determined in the white and blue parts of several pieces, and it was found that the material had originally been prepared with silicate of soda to the amount of about 8 per cent. upon the weight of the cotton fibre, and that the portions remaining in a sound condition left on burning but little more than a-half per cent. of ash. The removal of the silicate was thus proved to have had a beneficial effect upon the endurance of the fabric. Proceeding, in the next place, to examine the silicated pieces, it appeared that a considerable proportion of the silica had been rendered insoluble in water; indeed, the larger proportion was fixed by the cotton fibre, having been liberated by the action of carbonic acid upon the silicate, with corresponding formation of carbonated alkali. It had even been suggested by Mr. Walter Crum that not only was the carbonic acid in the air able to decompose the silicate of soda, but that cotton fibre itself might have the power of fixing the silica, and consequently of inducing the liberation of caustic alkali. It was well known that alkalies, both caustic and carbonated, seriously injured the quality of cotton goods, especially if left in contact for a long time; there was, he believed, an oxidising action set up which impaired the strength of the fibre, and besides this he conceived it possible that the mere increase of bulk consequent upon the deposition of silica within the cells had a tendency to cause rottenness. The whites were more injured than the blues, as was to be expected, since the indigo would first take possession of the interstices of the cellular tissue, and oppose the influence of the destructive silicate. The author described the process of treatment to which the cotton goods had been subjected, pointing out the common use of a "resist paste" of sulphate of lead with a little nitrate of copper, to prevent certain portions taking the indigo dye; the pieces were then calendered by passing over heated rollers, and in this operation should any free acid have been present in the copper salt a "softening" of the goods inevitably followed. With the intention of counteracting the effect of this acid, Dr. Calvert thought it probable that an alkaline bath of silicate of soda had been resorted to, without the knowledge that a similar evil from an opposite course would result. In this inquiry the speaker had derived assistance from Mr. Caro and Mr. Dancer, jun. The first-named gentleman proposed an explanation somewhat different from that which he had himself brought forward. Mr. Caro thought it more probable that the rottenness was ascribable to an increase of bulk consequent upon the action of silicate of soda upon the sulphate of lead in the whites, by which an insoluble silicate of lead, or possibly a double silicate, was formed, and that the expansion of the cotton-cells to an unnatural degree rent the fibre and impaired its strength.

The President moved a vote of thanks to Dr. Calvert for his communication, and for the opportunity of inspecting a series of instructive examples. For his own part, he considered the view entertained by the author—viz., that the presence of alkalies favoured the oxidation of organic substances—to be a rational explanation of the phenomenon.

Professor Abel said that some experiments he made a few years ago upon the preservation of canvas led him to a conclusion somewhat at variance with that propounded by Dr. Crace Calvert, and adopted by the President. He did not consider the rottenness of the goods to be the result of oxidation, but he would rather attribute it to a mechanical action upon the fibre exerted by the expansive force of crystallisation. The experiments to which he referred were made under conditions very similar to those described by Dr. Calvert: the canvas, or tent-duck, was first impregnated with a solution of basic acetate of lead, and subsequently immersed in aqueous silicate of soda, which had the effect of precipitating a dense silicate of lead within the fibre. The canvas thus prepared was found to be very considerably protected both against fire and the attack of mildew; but there was a diminution in the strength of the material, and the process had to be abandoned. As a confirmation of the correctness of his opinion, Mr. Abel mentioned the result of other experiments, in which flax and cotton fabrics were impregnated with sulphate of magnesia—a neutral salt, which could not be supposed to exert or promote a chemical action upon the fibre, yet the material became weakened merely in consequence of the deposition of solid matter within the fibre, and the unnatural distension of the latter by the act of crystallisation.

Dr. Frankland, having seen Mr. Abel's results and repeated some of the experiments, coincided in the opinion he had just now expressed. He thought there was a parallel between these recent observations and the old familiar fact that the strength of calico and linen cloths became decidedly impaired by frost acting upon them whilst moist. In the examples brought forward by Dr. Calvert he could easily imagine that the dyed portions, being already filled with indigo, would be less assailable than the white parts of the fabric.

Mr. J. T. Way said that the paper-makers had attempted to use silicate of soda as a mineral sizing upon Spanish grass; but the application did not prove successful. He was reminded of the principle of splitting the fibres of linen by Claussen's process, which failed from the circumstance of the material being injured both by the treatment with carbonated alkali and by the disintegrating action of the carbonic acid gas upon the walls of the cells. The chemical action of silicate of soda could not be much inferior to that of the caustic alkali itself, since the acid in combination was weaker even than carbonic acid. He should not have expected that carbonic acid would penetrate far into the bales, so tightly were the goods packed and so perfectly would the gas be absorbed by the outer layers.

Dr. Calvert explained how the goods were found to be deteriorated alike at one inch and at eighteen inches' distance inside the bales, and that even the pieces from the centre gave evidence of the silica having been partially separated and rendered insoluble in the fabric.

Dr. F. **Crace Calvert** then read a paper "*On the Crystallised Hydrate of Phenic Alcohol.*" The author exhibited some beautiful specimens of the new body (which closely resembled glacial acetic acid in colour and general appearance), and stated that it had been obtained by mixing together four parts of carbolic acid with one of water, and exposing to a temperature of about 4° C. with constant agitation. The sides of the vessel became coated with fine large crystals, which took the form of six-sided rhombic prisms. These crystals had a fusing point of 160° C., and they were soluble in water, alcohol, and ether. Their composition was expressed by the formula $C_{12}H_5O,2HO$, which shows it to contain one atom of water, in addition to the elements composing the ordinary monohydrated oxide of phenyl (carbolic acid). On applying heat to the crystals water distils over, and the temperature gradually rises to 187° C.—the boiling point of phenic alcohol. The author made passing allusion to the hydrate of propyl alcohol discovered by Erlenmeyer, and stated that his new substance was the first example known of an alcohol uniting with one equivalent of water to form a crystallised hydrate. Like the so-called carbolic or phenic acid, the solution of the crystals was destitute of acid properties, and did not, therefore, redden litmus paper; he preferred calling the first-named substance an alcohol, and conceived that it bore some analogy to glycerine. The author next described some remarkable results which he obtained by treating the ordinary phenic alcohol with solutions of caustic potassa, of gravities varying between 1·02 and 1·06, which tend to prove that the combination with alkali is not one of a definite character. By way of example, Dr. Calvert stated that if 100 c.c. of potassa solution, sp. gr. 1·03, be used as a solvent, and carbolic acid be added from a burette by measures of 25 c.c. at a time, it would be found that the first and the second portions enter into solution, but that on adding a third measure not only will it remain undissolved, but will determine the separation of a quantity of carbolic acid equal to itself, so that only 25, and not 50, are held in solution by the alkali. Again, carbolic acid may be distilled from a concentrated alkaline ley almost without loss. It absorbs ammonia gas with avidity, but gives it out again on heating; if, however, the ammoniated carbolic acid be heated in sealed tubes, it was known that it could be transformed into aniline and water. Under no circumstances was it possible to decompose an alkaline carbonate by carbolic acid. Both the monohydrate and bihydrate of oxide of phenyl dissolve oxide of lead, forming with it a solid white compound of definite formula

$$C_{12}H_6O_2 + 2PbO.$$

The **President** remarked upon the beauty of the specimens exhibited by Dr. Calvert, and said he should like to know, if it were possible to communicate the facts, how it happened that the commercial samples of carbolic acid manufactured under Dr. Calvert's direction at Manchester were permanently colourless, whereas the ordinary product invariably turned brown on keeping. He considered the weight of evidence in favour of regarding the substance in question as an alcohol, but it could not be doubted that it presented more marked acid properties than the alcohols of the ethyl series.

Dr. **Calvert** said in reply that considerations of trade interest compelled him to withhold the little piece of information which appeared to be of so much interest to the President. It was to him a fact of considerable scientific importance to know that carbolic acid could be turned out by the ton in a state so pure that the fusing point never varied one degree from the 34° C. which belonged to this body.

Professor A. H. **Church**, M.A., gave an account of "*Some Hydrated Cupric Oxychlorides from Cornwall.*" The author described particularly a new species of atacamite which he had lately received from Mr. Talling, of Lostwithiel. The colour of the mineral is turquoise-blue, it occurs in thin crusts, presenting a botryoidal appearance under the microscope. Its hardness is equal to 3, and density about 3·5. It is not attacked by water, but is readily soluble in dilute acids, and the solution gives the reactions of chlorine and copper. Besides these elements the mineral contains water. In the matrix were calcic sulphate, and ferric oxide, which had to be carefully separated from the sample analysed. The formula deduced from its quantitative examination was—

$$CuCl_2,4CuH_2O_2,4aq.$$

Besides differing in colour from the ordinary variety of atacamite, it contains more water, and more cupric oxide united to the chloride, a difference which has a parallel in the blue modification of brochantite, which, under the name of langite has been lately described by Professor Maskelyne. The formulæ of these several minerals were represented in series, thus—

Atacamite $CuCl_2,3CuH_2O_2,aq.$ (green)
New species $CuCl_2,4CuH_2O_2,4aq.$ (blue)
Brochantite $2CuSo_4,5CuH_2O_2.$ (green)
Langite $CuSO_4,3CuH_2O_2,aq.$ (blue)
Lyellite $\left.\begin{matrix}CuSO_4,\\ CaSO_4\end{matrix}\right\} 3CuH_2O_2,3aq.$ (blue)

The author stated that the sample of green atacamite analysed by him in order to furnish a comparison with the blue variety was found at St. Just, in Cornwall, and in a copper mine situate close to the sea; the amount of water is smaller than in other known varieties of the mineral. Its origin was attributable to the action of salt water upon copper lodes, and the chlorides both of sodium and magnesium were detected in the specimen. With regard to the new Cornish mineral, Mr. Church stated that a similar compound had been produced artificially by Sir Robert Kane: it contained, however, but two instead of four atoms of water. The author made some statements with regard to "*The Hydrated Cupric Oxysulphates from Cornwall,*" and challenged the accuracy of an analysis lately made by M. Pisani, who appears to have re-named the mineral discovered by Prof. Maskelyne, calling it now "Devilline," and attributing to it the mineralogical formula—

$$(\dot{C}u\dot{C}a\dot{F}e)_4\dddot{S} + 3aq.$$

The chief point at issue seems to be the question whether iron is a legitimate constituent of the mineral. Prof. Church believes that it occurs only as an impurity in the form of ferric oxide mechanically intermixed. The result of his analysis of the mineral "Lyellite" is stated above.

Mr. F. **Field** had frequently examined samples of the green atacamite, both of natural and artificial formation, but always found that they contained four equivalents of water. The occurrence of a blue variety of oxychloride of copper was an interesting fact.

Mr. **Newlands** objected to certain forms of expression made use of by Prof. Church in the latter part of his communication. It was stated that "if cupric chloride existed as such in the mineral, boiling water should remove it; the cupric hydrate would also be blackened by conversion into oxide." The speaker believed it was generally admitted that double salts were capable of exhibiting new properties. If this were not true, he might argue that the platino-potassic chloride does not contain chloride of platinum because it cannot be dissolved out by water. Besides, as to the fact, if the minerals were formed by the action of sea-water any soluble cupric chloride must be removed in the process of formation.

The **President** did not acquiesce in the use of the term "sulphuric anhydride" when the author said that "Lyellite contains copper, calcium, sulphuric anhydride, and the elements of water."

Professor Church defended himself by saying that it was difficult in the present day to avoid the charge of misrepresentation, for the same body was called by so many different names; that he had, in his paper, described the drying of his samples over "oil of vitriol," using the original name in preference to sulphuric acid, hydric sulphate, and other terms of later adoption. In employing the term "sulphuric anhydride," he meant to convey the information that the mineral contained the body which gives barium sulphate with chloride of barium; and at that stage of the qualitative examination he could not say how it was combined, for these particulars had to be considered later in the discussion.

The **Secretary** read the programme relating to the election of officers for a second time. In addition to the names already published was that of Dr. Frankland, as foreign secretary. The meeting was then adjourned until Thursday, March 16.

PHARMACEUTICAL MEETING.

Wednesday, March 1.

Mr. **Hills**, *Vice-President, in the Chair.*

The first paper read was "*On Phosphate of Ammonia of the British Pharmacopœia,*" by Mr. John Watts, Senior Bell Scholar. He considers the field of criticism of the British Pharmacopœia nearly exhausted, but in the prospect of a new edition every contribution towards an exact knowledge of the materia medica becomes of interest. With this idea he undertook the examination of the phosphate of ammonia which is produced when the directions of the Pharmacopœia are strictly followed. The formula, $3NH_4O,PO_5 + 5HO$, is ascribed to the compound, but the accuracy of the formula has been questioned. Generally speaking, when phosphoric acid is neutralised with an alkali, we do not obtain a salt with three atoms of base, but a compound of two atoms of base, one of water, and one of acid. The former result would appear to be much more doubtful in the case of an ammonia salt, since it is stated that the triammonic salt, if formed, cannot be dried, and retain its composition. The author found this assertion to be, to a certain extent, correct: when dried with all precaution, some ammonia was given off. In his analysis of the salt, therefore, the ammonia was always too low, and the phosphoric acid consequently too high. The general results, however, showed that for once the formula of the British Pharmacopœia was correct. Details of the analyses were then given, from which we quote only the percentage results:—

	I.	II.	III.		Calculation.
PO_5 .	38·06	38·02	37·89	PO_5 .	36·59
NH_4O .	39·05	38·2	—	$3NH_4O$.	40·20
				$5HO$.	23·21
					100·00

The phosphoric acid was estimated by means of nitrate of uranium, and also as pyrophosphate of magnesia; the ammonia was determined by Peligot's method. Allowing for unavoidable loss of ammonia, the above results agree sufficiently near with the Pharmacopœia formula, and there can be no doubt that the phosphate prepared according to it is a triammonic salt. No analysis of such a salt has, however, been published before. The author then pointed out that in the analysis of these phosphates it was impossible to say, from a determination of the ammonia alone, whether the compound was a di- or tri-ammonic salt, the proportion of ammonia in these two salts being the same—one containing five atoms of water, and the other none. Mr. Watts also analysed several specimens of commercial phosphate of ammonia. The mean of the results gave 53·29 per cent. of phosphoric acid, which closely agrees with the composition of the diammonic salt, requiring 53·79 of acid. As the samples were not purchased until after the publication of the British Pharmacopœia, the author considers that the salts were not made according to its directions, or came from an old stock, for, unless very carelessly kept, the tri- salt does not so completely change to the diammonic salt. The next questions discussed were, which of these two salts is the best for medicinal use, and which is most easily and cheaply prepared. In making the triammonic salt there is a great loss of ammonia, the product is always unstable, and there can be no use in having the three atoms of ammonia if they will not remain in the salt. On the large scale the manufacture of the triammonic salt is impracticable. In use it becomes converted into the diammonic salt. The author found that when fully exposed to air for two hours, the Pharmacopœia salt lost one atom of ammonia. A salt with two atoms of ammonia is, on the contrary, very stable, and can be easily prepared by a process similar to that employed for phosphate of soda. The solution kept faintly alkaline yields crystals of the exact composition which are permanent. If the solution be acid, the result is a mixture of the mon- and di-ammonic salt. The latter, then, undoubtedly appears the best from a pharmaceutical point of view. Mr. Watts related that he had only once seen phosphate of ammonia in a prescription, and then it was ordered by a member of the Pharmacopœia Committee in combination with bicarbonate of potash and citrate of lithia. The mixture of these salts was directed to be well dried, and since it was impossible for the triammonic salt to exist in such a condition, it may be inferred that physicians set but little value on the third atom of ammonia. Mr. Watts next referred to the arseniates as closely connected with the phosphates; all said about the latter will apply to the former salts. Triammonic arseniate agrees in every respect with the corresponding phosphate. Arseniates of commerce proved on examination to be mixtures of the mon- and di-ammonic salts. Their solution was faintly acid, which led to the conjecture that they had been crystallised from solutions, not preserved alkaline.

Dr. **Attfield** remarked that phosphate of ammonia was said to be administered in gout and rheumatism to render the urates of soda and lime in the blood soluble; he wished to ask Mr. Watts whether he had made any experiments to determine the solubility of these salts in solutions of the phosphate of ammonia?

Mr. **Watts** replied that at present he had made no determinations.

The next paper was "*On a Better Mode of Preparing Red Oxide of Mercury Ointment,*" by **Balmanno Squire**, M.B. Dr. Squire recommends the use of the precipitated binoxide of mercury for ointments in place of the nitric oxide, as it is called. The former, being in a much finer state of division, is more active, and a smaller quantity suffices. The smoothness of the ointment, besides, recommends it for application to delicate tissues as preferable to the gritty preparation which is got even with the best levigated nitric oxide. Comparative trials made with ointments prepared with the two oxides seemed to show the superiority of the precipitated yellow oxide, which the author hoped would come into general use.

Mr. **Shillcock** exhibited a "Poison Bottle" of his invention. The peculiarity was a simple contrivance for securing the stopper by means of a screw. A short discussion on poison bottles in general followed, in the course of which Mr. Morson sagaciously remarked that the best of them was but a clumsy substitute for the care and intelligence which should always be exercised when dealing with such important matters as remedies and poisons.

The meeting then adjourned until April 5.

ACADEMY OF SCIENCES.

February 27, 1865.

M. **Pelouze** described "*A New Compound of Water and Carbonate of Lime.*" The author has for some years studied the chemical reactions which take place at low temperatures, and has before shown that in some the changes which take place are different from those which happen at ordinary temperatures. Thus, at —15° binoxide of nitrogen combines with an alkaline sulphite to form a nitro-sulphite, while at 0° the same gas is completely destroyed, and, instead of a new salt, only a neutral sulphate and protoxide of nitrogen are obtained. He has now passed carbonic acid into lime-water cooled to 0° or + 1° or 2°, and found that a flocculent precipitate is at first formed, which soon changes to a heavy crystalline powder, and which, after washing with iced water and dried at a low temperature between folds of blotting-paper, is found to contain 52 per cent. of water. This corresponds to six equivalents of water to one equivalent of carbonate of lime; the formula of the salt, therefore, will be $CaO,CO_2 + 6HO$. A slight elevation of temperature soon decomposes this compound. At 30° it becomes a pasty mass, which is only a mixture of carbonate of lime and water, like ordinary chalk and water. The same compound is formed when solution of chloride of calcium and carbonate of soda cooled to 0° are brought together. A carbonate of lime with five equivalents of water is slowly formed when a solution of lime in weak syrup is exposed to the air, as Daniel and Becquerel have shown. Carbonic acid passed into a similar solution cooled to 1° or 2° gives rise to a salt with 6 HO. Between 10° and 20° the precipitates formed have only 27 per cent. of water. At 30° carbonate of lime is always anhydrous. Soluble salts are known to crystallise with various proportions of water, according to the temperature; but insoluble salts, like carbonate of lime, generally refuse to combine with water.

M. Persoz read a memoir "*On the Transformation of Protoxide of Nitrogen into Nitric Acid and Ammonia.*" Nitrous oxide, procured in the ordinary way from fused nitrate of ammonia, the author first passes into a cooled tubulated receiver to arrest most of the water, and then through a curved tube, the bend of which is filled with hydrate of potash mixed with lumps of lime, so as to allow gas to pass freely. The curve is heated to dull redness, and as soon as the current of moist protoxide is well established, an abundant disengagement of ammonia is recognisable, and after continuing the experiment for some time, nitric acid may be found in the saline mass in the tube. The author considers the molecule of nitrous oxide as more complex than is generally supposed, and thinks it contains besides the latent heat which keeps it gaseous, some accumulated heat which gives to it some of the properties of peroxide of hydrogen and other peroxides and acids, bodies which in their molecular changes disengage more heat than theory can account for. The doubled molecule, N_2O_2, he thinks comparable to some of the foregoing compounds. And now, as it then represents all the elements of nitrate of ammonia less four equivalents of water, we ought, by making it react on water, to regenerate the nitric acid and ammonia, which the author has done.

M. Deherain read a note "*On the Use of Gypsum on Arable Lands.*" The author says that gypsum changes carbonates of potash and ammonia, which argillaceous soil obstinately retain, into sulphates, which are not so easily retained, and hence he concludes that gypsum facilitates the passage of alkalies into the lower layers of soil, and so favours the vegetation of plants whose roots go deep (leguminous), while it has no effect on cereals, the roots of which do not go beyond the upper layer. The author explains the absence of sulphuric acid in the ashes of plants on the supposition that sulphates are reduced in the deep layers of soils.

M. Bechamp presented a note "*On an Albumenoid Ferment in the Urine.*" *Nefrozymase* is the name that the author has given to the new substance he has discovered in that much-studied, but apparently little-understood, fluid, human urine. To obtain the substance filter the urine of a healthy individual, and then carefully add twice or three times the volume of strong alcohol. A flocculent precipitate slowly collects, which must be washed with weaker alcohol (75 per cent.). The precipitate is a mixture of the albumenoid matter and earthy phosphates. Ordinarily, 1000 c.c. of urine contain from 0·3 to 0·65 grm. of the matter, but the quantity seems to vary, according to age, sex, diet, and time of day. Water will dissolve the matter, which gives all the chemical reactions of albumenoid matter, and possesses besides the properties of an active ferment. It quickly liquefies starch paste, and soon changes it into glucose; but it is less active in this respect than saliva and diastase. The author expects to show that the ferment is formed in the kidneys at the expense of the albumenoid matter in the blood, and he thinks the body of great pathological importance. The urine of dogs and rabbits also furnishes nefrozymase.

M. Reveil read a long memoir "*On the Application of Dialysis to Toxicological Researches, and the Use of the Iodide of Mercury and Potassium as a Test for Alkaloids.*" We see nothing new in the author's summary, except the statement that the separation of crystalloid from colloid bodies is much more rapid when there is a great difference of temperature between the liquid in the dialyser and the diffusate—a condition of things which it is admitted is difficult to maintain.

A note "*On the Sucrates of Lead,*" by MM. Boivin and Loiseau, tells us that the authors believe in a radical $C_{12}H_8O_8$ sucric acid—a tribasic acid, which, with three of water, forms crystallised sugar $C_{12}H_8O_8 3HO$, or a tribasic sucrate of water, the type of all sucrates. The so-called bibasic sucrates they consider $C_{12}H_8O_8HO,2MO$, and they remark that these salts are in general found at a low temperature. The sucrates of lead seem to possess no particular interest.

MM. P. and E. Depoully communicated "*A New Method of Making Benzoic Acid.*" They mix an equivalent of neutral phthalate of lime (bicalcic phthalate) with an equivalent of hydrate of lime, and heat it to 330° or 350° for some hours protected from too much air. At the end of this time the salt is completely changed into benzoate and carbonate of lime.

$$C_{16}H_4CaO_8 + CaO,HO = C_{14}H_5CaO_4 + 2CaOCO_2.$$

The benzoate of lime may be extracted by water, and the benzoic acid precipitated from the concentrated solution. This splitting up of phthalic acid was foreseen by Gerhardt and Berthelot, and was attempted without success by M. Dusart.

A note by M. Vionnois "*On the Reflection of Sound*" explains the cause of rolling thunder. He was at the camp at Nancy, and heard the echo of the firing, not sharp and dry, but somewhat confused and prolonged. He then noticed that he was separated from the field by some trees, and concluded that the leaves of these were the reflecting surfaces. This led him to think that the explosion of the electric spark might be reflected by the vesicular vapour of the clouds, and the noise be softened and prolonged by the inequality of the distances and the successive reflections.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, February 21, 1865.

R. Angus Smith, *Ph.D., F.R.S., &c., President, in the Chair.*

Mr. Thomas Worthington was elected an ordinary member of the Society.

M. Breguet, of Paris, exhibited and explained the construction of Dumas' lamp for use in coal mines, the principle of which consists in the employment of the light from a Geissler's vacuum tube, excited by a small Ruhmkorff's induction coil.

Professor Roscoe stated that he had very frequently been asked for information respecting the mode of preparing the sealed bulbs, containing exactly equal volumes of chlorine and hydrogen gases, which he employed for exhibiting the chemical combination of these gases effected by the action of light, and as the successful preparation of these bulbs depends upon exactly observing certain minute conditions, he ventured to submit the following particulars to the Society. The apparatus needed consists of a stout tube or narrow bottle of about 120 cubic centimetres capacity, fitted with a caoutchouc stopper with three holes bored through it. Into one of these holes a vent gas delivery tube passes, on to which three small wash bulbs are blown; into the other two holes are inserted the rounded ends of two lengths of the gas carbon, commonly used as terminals for the electric lamp; these poles are of such a length that they pass to the bottom of the glass bottle. This is then filled with strong aqueous hydrochloric acid containing about 30 per cent. of the anhydrous acids; the stopper in the poles and wash bulbs containing a few drops of water is then fixed into its position, and the evolution vessel placed in a beaker of cold water, whilst contact is made with the terminals of four ordinary sized Bunsen's cells, the whole apparatus being placed in a dark room. The mixed gases at once begin to be given off, and ought to pass through the wash bulbs at the rate of about two bubbles per second. It is absolutely necessary that the gas be allowed to come off at this rate for three hours* before it is collected, as up to this time it does not attain a sufficient degree of purity and sensitiveness, whilst after the lapse of this time it is generally found to be fit for use. In order to absorb the excess of chlorine, the waste gas may be led into a condenser containing slacked lime and charcoal in alternate layers. When the evolution has gone on for the above-mentioned time a bulb tube, connected by caoutchouc joinings, is placed between the evolution vessel and the condenser, and the gas allowed to pass through. The bulbs, which are made of fusible glass tubing, are blown about the size of a hen's egg, and so thin that they easily break when pressed with the finger. At each side of the bulb the tube is drawn out so as to be very thin in the glass, and to leave the internal diameter not less than 1 mm., whilst at the extremities the tube is wider, so as to fit ordinary joinings. When the gas has passed through the tube for about ten minutes, the joinings are loosened and each end stopped with a piece of glass rod. The bulb tube thus closed is then removed from the evoluting vessel, and the thinnest part of the tube brought some little distance above a very small Bunsen's flame; the glass then softens below a red-heat, and the ends may be drawn out and sealed with safety. It is advisable to number the bulbs, and to test the first and last by exposing them to a strong light. Frequently, in spite of every precaution, the gas explodes during the act of sealing, so that in this operation it is advisable to hold the bulb with a cloth rather than in the open hand. As soon as one bulb-tube is removed, another is placed in connection with the evolution flask, and, after ten minutes, sealed as described. The above quantity of acid will serve for the production of sixty bulbs. Thus prepared, the sealed bulbs may be kept in the dark for any length of time without injury; some, which were known to have been made more than a year, were found to be perfectly good. To explode these bulbs it is only necessary to expose them to diffuse daylight or sunlight, when the combination occurs instantly. Of artificial lights, the bright flash produced by the combustion of the vapour of bisulphide of carbon in nitric oxide is most effective; but the light of burning magnesium wire, of phosphorus in oxygen, or the electric light, answers perfectly well. Professor Roscoe stated that Mr. Dancer, of Cross Street, had undertaken to supply the bulbs to persons unable to prepare them.

A paper was also read "*On the Action of Caustic Soda on Ethylic and Methylic Alcohol*," by Mr. A. Mylius, which we shall give in a future number.

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* See Bunsen and Roscoe, "Photochemical Researches," 1857, p. 355.

NOTICES OF BOOKS.

The Spirit of Nursing. By Harry Jones, M.A. London: Hardwicke. 1865.

It may be asked what chemists have to do with nursing. But all of us have once been infants, and every average life, the statisticians tell us, must expect so many weeks (we forget how many) of sickness; and, moreover, some of us may live to get old. And all we need say respecting this little book is, that for infancy, sickness, or old age, give us such an attendant as is here sketched by Mr. Jones.

Bulletin de la Société Chimique de Paris. February, 1865.

We noticed the proceedings of the Chemical Society of Paris in our last number, but now refer at greater length to some of the communications made to the Society. M. Jodin, in his paper "*On the Changes in Vegetable Tissues under the Influence of Air and Light*," detailed some experiments the results of which he communicated some months ago to the Academy of Sciences, and so noticed at the time in the Chemical News (vol. x., p. 273). Although there was nothing new in the results obtained, some of the experiments are novel. The author destroyed the vitality of green leaves by immersing them in alcohol, or heating them to a high temperature in sealed tubes, and found that after this the leaves still presented some signs of life. In the light they were rapidly decolorised, but excluded from air and light they preserved their greenness for an indefinite time. In the course of the decoloration by solar light, he proved that oxygen was absorbed and carbonic acid evolved. Under the same circumstances he found the yellow matter in etiolated leaves to absorb oxygen. On the contrary, it was proved that etiolated leaves, in becoming green in the light, evolved oxygen, while those kept in the dark and unchanged in colour absorbed oxygen. The author is disposed to regard chlorophyll as a body quite distinct from the yellow colouring matter of leaves.

M. Lieben's paper "*On Anomalous Vapour Densities*" is a reply to M. Deville. It is impossible to condense the reasoning of the author, who contends that the experiments of M. Deville on the vapour density of chloride of ammonium are not in contradiction to the law of Avogadro and Ampère.

In a communication "*On the Constitution of Aromatic Substances*," M. Kekulé developes some views which could not be made intelligible without the diagrams here given. He considers that in all aromatic substances there is a common group, a sort of nucleus, formed of six atoms of carbon. His reasons for thinking so are—1, that even the simplest aromatic substances are relatively richer in carbon than the analogous fatty substances; 2, that homologous substances (that is to say, bodies which differ from each other by $n\mathrm{CH}_2$) exist in aromatic groups; 3, that the simplest bodies belonging to an aromatic group contain at least six atoms of carbon. Further, by the influence of energetic reagents, we always derive, even from relatively complex matters, substances which only contain six atoms of carbon (benzine, phenic alcohol, picric acid, aniline, &c.). M. Kekulé supposes that in the interior of the nucleus the carbon exists in a more condensed state than in the fatty substances. He then proceeds to explain the constitution of the nucleus according to his own view of the tetratomic nature of carbon. He supposes that the six atoms of carbon may unite in such a way that either eight or six affinities remain unsaturated. From the latter combination, which the author designates *a closed chain*, aromatic substances are derived; from the former, called an open chain, such derivatives as quinone and chloranide are formed. These modes of combination are represented pictorially in diagrams, some of which we may reproduce hereafter.

In the analysis of foreign memoirs which follows the proceedings of the Society we find few papers of interest which we have not noiced.

A note by Beilstein "*On the Reducing Action of Tin and Hydrochloric Acid on Nitrated Bodies*" shows that in this action the whole of the $N\Theta_2$ in a body is replaced by NH_2, which does not happen when sulphuretted hydrogen is employed. Tin and hydrochloric acid may, therefore, be used to reduce all nitrated bodies, while iron filings and acetic acid are only convenient when the product found is a volatile base.

M. E. Kopp continues his paper "*On Artificial Colouring Matters*," in which we find little which has not appeared in our pages. In this chapter he quotes from M. Krouber, to the effect that the light oils, the boiling points of which lie between 90° and 110°, yield the best aniline for the manufacture of colours. Such oils will, in fact, consist almost entirely of benzole and toluol.

Annalen der Chemie und Pharmacie. February, 1865.

We find nothing of general interest in this number which we have not before noticed, except a curious paper by Schwarzenbach "*On the Relation of Albumen to Caseine.*" The author has examined platinocyanides of these bodies; and from their analysis he concludes that the combining proportion of caseine is exactly the half of that of albumen (albumen = 1612; caseine = 806)—in other words, caseine is albumen split asunder.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

222. J. H. Pepper, Boundary Road, St. John's Wood, and T. T. Tobin, North Street, Pentonville, "A new or improved apparatus for illusory exhibitions."—Petition recorded January 26, 1865.

320. W. E. Newton, Chancery Lane, "Improvements in the preparation of superphosphate of lime."—A communication from R. B. Potts, Camden, New Jersey, U.S.A. February 4, 1865.

414. W. C. Hine, Swineshead, Lincoln, "Improvements in stoppering bottles or other similar vessels, and measuring quantities therefrom."—February 14, 1865.

437. R. H. Emerson, Dublin, "A new or improved invalid or syphon drinking cup."—February 15, 1865.

447. W. E. Newton, Chancery Lane, "Improvements in apparatus for distilling petroleum and other volatile liquids and for making gas."—A communication from G. H. S. Duffus, New York, U.S.A.

448. J. F. Hearsey, Park Place, Brompton, "Improved apparatus for measuring the specific gravity of liquids."—A communication from E. Payne, Montreal, Canada.

449. F. A. Laurent, J. Carthelaz, and N. Basset, Rue St. Croix de la Bretonnerie, Paris, "Improvements in the manufacture of oxalic acid."

451. R. Smith, Cumming Street, Pentonville, Middlesex, "Improvements in treating sewage, and in arranging apparatus in sewers and culverts to facilitate the ventilation of such structures."—Feb. 16, 1865.

456. J. O. Christian, F.C.S., Manchester, J. Charlton and H. Charlton, of Strangeways, Lancashire, "Certain improvements in the manufacture of magnesium and its compounds."

460. C. F. Claus, Fernhead, Lancashire, "Improvements in obtaining sulphates and carbonates of potash and soda."—Feb. 17, 1865.

465. C. Brakell, W. Hoehl, and W. Günther, Oldham, Lancashire, "An improved composition as a substitute for leather or other similar materials."

467. R. A. Brooman, Fleet Street, London, "Improvements in filters."—A communication from G. Planche, Paris.—Feb. 18, 1865.

486. W. E. Newton, Chancery Lane, "Improvements in apparatus for extracting liquid from solid substances."—A communication from L. Smith, Erie, Penn., U.S.A.—Feb. 21, 1865.

Notices to Proceed.

2581. W. Taylor, Shiffnal, H. Harrison, and G. Harrison, Hollingswood, Shropshire, "Certain improvements in the manufacture of iron."—Petition recorded Oct. 19, 1864.

2605. L. Paviola, La Crotat, France, "An improved anti-saline coating, chiefly applicable for preserving from corrosion and incrustation the boilers and pipes of marine steam engines."—Oct. 21, 1864.

2645. J. Dannatt, Sunderland, Durham, "An improved composition for preventing the fouling of the bottoms of ships and vessels, and for the preservation of the iron or wood of which the same are constructed."

2646. P. Dutrulle, Davies Street, Grosvenor Street, Grosvenor Square, "Improvements in the manufacture of syrups." A communication from J. J. Grosheing and A. Sheurer, Logelbach, Haut Rhin.—Oct. 26, 1864.

2666. D. Laidlaw and J. Robertson, Glasgow, N.B., "Improvements in exhausting, forcing, compressing, heating, cooling, and applying aëriform bodies, and in apparatus therefor."

2673. W. Cormack, Little Moorfields, "Improvements in the distillation or destructive distillation of solid matters or semi-solid matters capable of yielding fluids or gaseous hydrocarbons, or other products, such as pit coal, boghead, or other bituminous coal or shale, peat, wood, asphalts, tallow, lard, fats, or other solid or semi-solid matters, and in the machinery or apparatus employed therefor."—Oct. 28, 1864.

2800. W. Willis, Birmingham, "Improvements in processes for copying or reproducing by the agency of light drawings, engravings, lithographs, and photographs, and written and printed documents."—Nov. 11, 1864.

2844. M. Henry, Fleet Street, London, "Improvements in the mode of, and apparatus for, carbonising wood and performing other operations in which substances are treated by flame or heat."—A communication from P. Hugon, Boulevart St. Martin, Paris.

2889. S. Piesse, New Bond Street, Ph.D., "Improvements in apparatus for creating and projecting cold vapours."—Nov. 18, 1864.

176. B. F. Stevens, Henrietta Street, Covent Garden, "Improvements in vulcanising compounds and vulcanised fabrics."—A communication from S. Stevens, New York, U.S.A.—Jan. 20, 1865.

330. A. A. Hulot, Imperial Mint, Paris, "A new typographic ink."—Feb. 6, 1865.

418. A. Fryer, Manchester, "Improvements in the mode of treating for evaporating and concentrating purposes cane juice and saccharine and other solutions and liquids, and also in machinery or apparatus for the concentration of cane juice and saccharine and other solutions and for the evaporation of liquids."—Feb. 14, 1865.

CORRESPONDENCE.

Continental Science.

Paris, March 7.

The Chemical Society of Paris seem to be in a flourishing state financially as well as scientifically. The treasurer's account for the past year shows a considerable balance in hand, although under the head expenditure I notice an investment made this year in the shape of seven railway shares. This in England would seem an odd way of investing money for a learned society; but, as all French railways will in time become the property of the State, I suppose it may be considered in the light of an investment in the funds. The Society has now received what is equivalent to a charter of incorporation in England, and can legally accept legacies, so I have no doubt its circumstances will soon still further improve.

I rather think that I have read the following information in the Chemical News already, but as I find it in *Les Mondes* as novel I will send it. Speaking of *Les Mondes*, I may say that the *jours gras* have brought a *jour maigre* for the readers of that journal, the learned editor having fallen back on an old stock, among which I fancy he found the news (?) that the prize which is awarded by the Belgian Government every five years for the work of the greatest merit on the mathematical and physical sciences published in the interval, has been conferred for the last quinquennial period, 1859-63, on M. Stas for his researches on the reciprocal relations of atomic weights. The jury in their report dwell particularly on the really scientific object of the author's researches, and speak of the rare merit of their execution, praise in which all who know the work in question will cordially join.

A curious form of native iron is said to be found in many Swedish lakes. It is dredged up from the bottom of the lakes in the shape of small hollow globules which are sometimes full, and always covered with something which protects the metal from oxidation. The people dredge it up periodically, and find that from time to time new deposits are formed, which are not sufficiently deep to pay for the dredging until twenty-five or twenty-six years have elapsed. The metal has always been supposed to be formed by the reduction of the oxide brought by natural drainage through a highly ferruginous soil, but still it was difficult to explain by what agent the reduction was effected, and to account for the peculiar globular form, and the circumstance that the metal resisted oxidation. Accident, however, has recently enabled Dr. Sjogreen to make the discovery of the true origin of the metal. He has found that the water of the lakes is full of infusoria; and he has watched them all busily occupied in surrounding themselves with an envelope of oxide of iron from which they absorb the oxygen, and become encased in a shell of pure iron during the larva state. The perfect insect escapes from his suit of mail through a hole left for the purpose. How the iron is preserved from oxidation Dr. Sjogreen has not yet been sharp enough to discover, but he will no doubt tell us some day. In the meantime he has certainly written a curious paper on lake ore.

In the dearth of chemical novelties, I may mention that Signor Bianconi contends that the *Epiornis maximus* was a species of vulture closely allied to the condor.

The magnesium light may after all turn out to be of some use. There is no taking decent photographs by means of it, but it certainly does light up dark places well, and M. Maisonneuve has been looking by its help into a patient's larynx, where everything was seen as clear as daylight.

Boussingaultite.

To the Editor of the Chemical News.

Sir,—In your valuable journal for January 27 is an account of the proceedings of the Chemical Society for January 19, in which Mr. Buckton, in describing the native sulphate of ammonia from Tuscany, mentions that this salt has lately been obtained by passing a mixture of sulphuretted hydrogen, atmospheric air, and steam through a heated earthenware tube. It does not there appear whether this very interesting observation is due to Mr. Buckton or another. Perhaps he will kindly communicate through your pages some further information on the subject, and oblige a fellow-chemist.

I am, &c. F.R.S.

Montreal, February 16.

On Cotton Seed Oil.

To the Editor of the Chemical News.

Sir,—In reference to Dr. Adriani's letters on this subject, I may state that I know of three or four large firms at the present time who are, and have been for a considerable time, refining large quantities of cotton seed oil. I know one firm who tried some years ago to obtain a green dye from the refuse in the process without success. Also, I worked for some time on the subject in endeavours to make the green fatty matter suitable as a dye, altogether without success. There are some great reasons why a solution of caustic soda will not answer on the large scale in refining the oil; and I was surprised to see Dr. Adriani says that he could obtain a good result by the use of this reagent.

The green fatty matter is soluble in coal naphtha, which, on evaporation, leaves a residue of a brown colour, and which is soluble in alkalies, and may be reprecipitated in a green mass by acids. By precipitation with copper, or barium, or calcium salts, the fatty matter is thrown down as a salt or insoluble soap of a dirty green colour.

The practical loss in refining is, as far as I can learn, about 10 per cent. Immense quantities of the pure or refined oil are shipped for Italy. Whether we eventually take cotton seed oil in our salad as olive or Gallipoli oil, I leave to you or your readers to say. I am, &c.

John S. Blockey.

Leeds, February 27.

[We have ourselves seen soda used with success in the refining of cotton oil on a large scale, but with a considerably greater loss than our correspondent states. Potash, for some reason or other, answers the purpose of "cutting down" the oil much better. The refined oil is notoriously exported for the adulteration of olive oil.—Ed. *C. N.*]

Metallic Vegetation and Veins.

To the Editor of the Chemical News.

Sir,—On the subject of the "scientific curiosity" mentioned by your Paris correspondent in his last letter, I would beg to submit to such of your readers as may be interested in the matter an account of an experiment I made about two years ago while investigating the properties of alkaline silicates.

The experiment is very simple, and will have not only a very beautiful effect, but, contrary to that of M. Jules Faure, shaking will not destroy the arborescent-like growth, nor at all affect its beautiful appearance when formed.

Let a solution of chromate of potash be mixed with a clear solution of silicate of soda to such an extent that when gently heated the two solutions may form a gelatinous mass. Let this settle in a clear glass vessel. Then take crystals of sulphate of copper coarsely powdered, cause them to be dropped in small scattered quantities on the surface of the mass. Wherever a particle of the sulphate of copper touches the surface of the gelatinous silicate, a pellicle of chromo-silicate of copper will form. The particle then falling to the bottom, the same compound forms along its course downwards, but at first invisible to the eye; but when each particle arrives at the bottom a fresh growth of the mineral ore begins to ascend along the course by which it has descended, and so on from each individual particle up to the spot where it originally touched the surface; there it joins the pellicle, and the growth ceases.

I think the mineral veins thus formed are tubular. The place where the particle of crystal first touches the gelatinous mass will be greater in diameter than the rest of the tubular structure, and the whole will bear a striking resemblance in form to a growth of cup-moss lichen (cladonia pyxidata). The gelatinous mass, when exposed to the air, will become solid, but will retain its original transparency, and the beautiful mineral arborescence may be preserved in that state for an indefinite period.

By varying the experiment, and using other gelatinous silicates and crystals of other metallic salts, very instructive lessons may be gained, and the experimenter may have formed before his eyes and become the possessor, within a few hours on a fine summer's day, of a number of miniature mines of lead and iron, zinc and copper, and silver and gold, the ores of which he will see branching in veins through the transparent matrix; and the reflection will occur to him that he is witnessing on a small scale a close imitation of some of Nature's own grand formations.

I am, &c. HENRY ELLIS, M.R.C.S.

Bangor, March 3rd, 1865.

MISCELLANEOUS.

Chemical Society.—The next meeting of this Society will be held on Thursday, March 16, at eight o'clock, when the following papers will be read:—"Action of Chlorine on Arsenious Acid," by Professor Bloxam; "Vapour Densities," by Mr. J. A. Wanklyn.

Royal Institution.—The following are the arrangements for the ensuing week:—Tuesday, March 14, at 3 o'clock, Professor Hofmann, F.R.S., "An Introduction to Chemistry." Thursday, March 16, at 3 o'clock, Professor Hofmann, F.R.S., "An Introduction to Chemistry." Friday, March 17, at 8 o'clock, Balfour Stewart, Esq., "On the Latest Discoveries Concerning the Sun's Surface." Saturday, March 18, at 3 o'clock, Professor Marshall, F.R.S., "On the Nervous System."

A Revised Pharmacopœia.—The Medical Council has appointed Mr. Warrington, F.R.S., and Professor Redwood to revise the British Pharmacopœia, with a view to the publication of a new edition as soon as possible.

Malt as Food for Cattle.—A preliminary report by Mr. Lawes establishes that the increase of live weight in animals fed upon malt is less than in those fed on unmalted barley. In the case of cows, too, less milk was given by the malt-fed than by the barley-fed animals. The experiments of Mr. Lawes were very conclusive, and appear to have been very fairly conducted.

Ozone and Antozone.—We understand that Schönbein has at last been successful in his long endeavours to isolate the bodies of which he has contended that ordinary oxygen is composed. Antozone, it is said, has a lower specific gravity than hydrogen. It liquefies at a pressure of 150 atmospheres. Ozone is a denser gas. The two gases combine with a loud explosion when exposed to the actinic rays of the spectrum. Another curious fact mentioned is that a spark of positive electricity does not effect their combination, which is only determined by a negative spark. If confirmed, this is without doubt the greatest chemical discovery ever made, and we shall present our readers with the memoir as soon as we can obtain it from Munich, to the Royal Society of which city the author has communicated his discovery.

Failure of the Metropolitan Gas Regulation Act.—We are sorry to see that the first prosecution instituted under this Act has failed from an apparent oversight of the framers of the Act. The prosecution was instituted by the City Sewers' Commission, of which it seems all the aldermen are members by virtue of their office. Consequently, it is held that no alderman can hear a complaint made by the Commission. This state of things we should hope would be remedied at once. The lighting of our streets and houses in some districts of London is at present disgraceful. A person compelled to walk through some localities after the shops and public houses are closed, now finds a condition of things which can hardly be better than in the old days of oil lighting. The Gas Regulation Act was a great legislative mistake, but its complete failure in improving or even maintaining the quality of the gas supplied by the companies must be ascribed to causes into which we dare not particularly enter. But we have no hesitation in saying that district Medical officers of health, sometimes in large practice, can hardly have time to devote to the duties of a gas inspectorship, even if they had the knowledge to qualify them for the post.

Arborisations Produced by Sulphate of Copper in Solutions of Alkaline Silicates.—By placing a few crystals of sulphate of copper or iron in a very diluted solution of silicate of potash, a mineral vegetation is formed in a few hours, of the same colour as the sulphate employed; this arborisation is remarkable, as it seems to reproduce in the solution of silica the mossy appearance seen in agates; by attentively following its growth some curious phenomena are observable. The stalks very often rise in the form of an arch; this takes place when the solution is at a certain degree of saturation; if it is very much diluted the arborescence rises vertically and in a straight line. If it is too much concentrated no arborisation takes place, the sulphate of copper merely becomes covered with a black coating. But in a properly dense solution a curious fact is observable; after the formation of the vertical stalks, fresh branches form upon them, inclining horizontally at an angle which is the same for all in the same solution. In solutions of different densities the most concentrated gives to these branches the most acute angle. What can be the cause of this regularity in the incline of such tenuous fibres? This problem is certainly as yet unresolved, but until it be resolved we hazard the following explanation:—The helicoidal form of certain fibres sufficiently indicates that they are arrested in their development by the density of the liquid, they then curve in the line which most easily enables them to overcome this resistance; but there must be another cause for those fibres which follow an oblique line always equally inclined, for they evidently follow this direction on account of the slight resistance thus offered to their development. The reason for this appears to exist in a kind of invisible cleavage possessed by the solution; if it be admitted that this cleavage exists according to a rhombohedral, as silica belongs to this system, all will be explained, for the terminal edges as well as the faces of this form are inclined horizontally. The arborisation produced by this experiment is very curious, for in the space of one day a prepared solution may be filled with vegetation varied according to the sulphate employed, and presenting an exact miniature representation of a forest. To render the experiment more interesting the bottom of the glass jar may be strewn with well-washed sand, and the addition of a few pieces of bichromate of potash will give to this the natural colour of soil, and parts of it powdered over with sulphate of copper will have the appearance of grass. It is hardly necessary to add that the vessel should never be moved when once the experiment is commenced.—*Les Mondes*, vii., 344.

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the EDITOR, and *Advertisements* and *Business Communications* to the PUBLISHER, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. *Private* letters for the Editor must be so marked.

S. M.—You will find a good deal of information on the subject in Cooley's "Dictionary of Practical Receipts." We know of no book exclusively devoted to the subject.

Jeremiah.—A "Doctor" may be anything he pleases. We have known one a crossing-sweeper, who made more by the handle of his broom than the handle to his name. The gentleman is the member of a wealthy city firm.

F.C.S.—To the several correspondents who have addressed us under this signature, we can only say that the matter is one upon which we are obviously precluded from expressing an opinion. Country members cannot vote unless present.

Received.—R. R.; G. C.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

An Introduction to Chemical Philosophy, according to the Modern Theories, by Adolphe Wurtz, *F.R.S.*

Part I.

Equivalents, Atomic Weights and Molecular Weights.

Section I.—*Historical Development of the Ideas, Equivalent, Atom, Molecule.*

(*Continued from page* 110.)

Gerhardt's Atomic Weights and Notation.—Gerhardt returned to the atomic notation, but he introduced important modifications into it. At first he met with the inconveniences of the system of equivalents when he attempted to formulate the composition and reactions of organic bodies. By adopting for carbon, hydrogen, and oxygen the equivalents 6, 1, and 8, the formulæ of organic compounds became such that the number of equivalents of carbon was always divisible by two; or, in other words, the organic molecules always increased by double equivalents of carbon; moreover, when these molecules were destroyed, or by any energetic action lost carbon as carbonic acid, or hydrogen as water, there was never disengaged one equivalent of carbonic acid CO_2 or one equivalent of water HO, but two, or a multiple of two equivalents of carbonic acid or water.

Gerhardt was led to *this* strange result of equivalent notation. Why, said he, should no reaction of organic chemistry give rise to one equivalent of carbonic acid or one of water? This is apparently caused by some fault committed in the determination of the atomic weight of carbon and of oxygen. In fact, if the smallest quantity of carbonic acid which is produced by one molecule is C_2O_4, this amount undoubtedly represents one molecule of carbonic acid. This, therefore, contains 12 of carbon and 32 of oxygen, and it will be more convenient to represent this by the formula CO_2, in which C represents 12 of carbon and O 16 of oxygen. On the other hand, if the smallest quantity of water produced by a reaction is H_2O_2, this quantity represents a molecule of water, and it had better be expressed by the formula H_2O, in which H represents 1 of hydrogen and O 16 of oxygen. This was returning to the atomic weights given by Berzelius for hydrogen, oxygen, and carbon; for the numbers 1; 16; 12 are proportional to the numbers 6·28; 100; 75. It was likewise coming back to the atomic notation which is founded on the considerations of volumes—that is to say, to the law of Gay-Lussac. To my mind, Gerhardt did not insist on this double characteristic. If he had invoked in favour of the reform he was endeavouring to inaugurate the two great names of Gay-Lussac and Berzelius, he would have easily quieted the mistrust of some and the opposition of others. "See," a diplomatist would have said, "I am returning to the notation with which you have been quite familiar; I merely introduce to it certain changes rendered necessary by the progress of science." But the strength of his conviction and the warmth of his character led him to less moderate and admissible expressions.

In fact, the alterations in the system of atomic weights and of notation which he introduced into Berzelius' notation were really insignificant. Like him, he doubled the equivalents of hydrogen, chlorine, bromine, iodine, fluorine, nitrogen, phosphorus, and arsenic to convert them into atomic weights.* But he extended to the metals themselves this reduction of the equivalents to one half. Adopting and developing an idea first started by Laurent, he compared the oxides, RO, with water, and assumed that they contained two atoms of metal to one of oxygen. The density of mercury vapour (6·9) compared with that of oxygen (1·1056) furnished him with a powerful argument in favour of this theory. To form oxide of mercury would require two volumes of mercury vapour and one volume of oxygen, for

$$\frac{2 \times 6{\cdot}9}{1{\cdot}1056} \text{ is practically} = \frac{100}{8}.$$

If the atomic weight of oxygen is 8, that of mercury would be 50, and the formula of oxide of mercury Hg_2O. Analogy leads to classifying the other protoxides under the general formula R_2O, and to doubling the equivalents of the metals contained in them.

Such are the fundamental points of Gerhardt's system of atomic weights, and of the notation which springs from it.

For certain bodies this notation is similar to that of Berzelius, but for others it is very different. In all cases it is developed from an obvious consequence of the theory of volumes. With few exceptions the formulæ of volatile compounds answer to two volumes of vapour. In the notation of Berzelius, the same formulæ answer sometimes to two, sometimes to four, volumes of vapour, as may be seen by the following table:—

Names of the Compounds.	Berzelius's Notation.		Gerhardt's Notation.	
Water	H_2O	= 2 vols.	H_2O	= 2 vols.
Sulphuretted hydrogen	H_2S	= 2 vols.	H_2S	= 2 vols.
Hydrochloric acid .	H_2Cl_2	= 4 vols.	HCl	= 2 vols.
Hydriodic acid . .	H_2I_2	= 4 vols.	HI	= 2 vols.
Ammonia . . .	N_2H_6	= 4 vols.	NH_3	= 2 vols.
Phosphurettedhydrogen	P_2H_6	= 4 vols.	PH_3	= 2 vols.
Arseniuretted hydrogen	As_2H_6	= 4 vols.	AsH_3	= 2 vols.
Hypochlorous acid gas .	Cl_2O	= 2 vols.	Cl_2O	= 2 vols.
Hypochloric acid gas .	Cl_2O_4	= 4 vols.	ClO_2	= 2 vols.
Protoxide of nitrogen .	N_2O	= 2 vols.	N_2O	= 2 vols.
Binoxide of nitrogen .	N_2O_2	= 4 vols.	NO	= 2 vols.
Hyponic acid . .	N_2O_4	= 4 vols.	NO_2	= 2 vols.
Nitric acid N_2O_5,H_2O =	$N_2H_2O_6$	= 4 vols.	NHO_3	= 2 vols.
Nitrates N_2O_5,RO =	N_2RO_6	—	NRO_3	—
Anhydrous sulph. acid	SO_3	= 2 vols.	SO_3	= 2 vols.
Sulph. acid SO_3,HO_2 =	SH_2O_4	—	SH_2O_4	—
Sulphates SO_3,RO =	SRO_4	—	SR_2O_4	—
Carbonic oxide . .	CO	= 2 vols.	CO	= 2 vols.
Carbonic acid . .	CO_2	= 2 vols.	CO_2	= 2 vols.
Carbonates Co_2,RO =	CRO_3	—	OR_2O_3	—
Cyanogen . . .	C_2N_2	= 2 vols.	C_2N_2	= 2 vols.
Hydrocyanic acid . .	$C_2N_2H_2$	= 4 vols.	CNH	= 2 vols.
Acetic acid . . .	$C_4H_8O_4$	= 4 vols.	$C_2H_4O_2$	= 2 vols.
Alcohol . . .	$C_4H_{12}O_2$	= 4 vols.	$C_2H\ O$	= 2 vols.
Ether	$C_4H_{10}O$	= 2 vols.	$C_4H_{10}O$	= 2 vols.

A comparison of these two systems of formulæ will

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* Gerhardt said:—We must either double the equivalents of hydrogen, chlorine, bromine, iodine, fluorine, nitrogen, phosphorus, arsenic, and the metals, or else we must retain the ordinary equivalents for these, and double those of oxygen, carbon, sulphur, and selenium. In either case we get the same result. This will be seen by looking at the following table, in which are given the numbers obtained in each of these two cases:—

		H.	Cl.	Br.	I.	N.	P.	As.	K.	Hg.	O.	C.	S.	Se.
Equivalents		1	35·5	80	127	14	31	75	39	100	8	6	16	40
Atomic weights	I.	½	17·75	40	63·5	7	15·5	37·5	19·5	50	8	6	16	40
	II.	1	35·5	80	127	14	31	75	39	100	16	12	32	80

Gerhardt thought that it would be more convenient to adopt the latter numbers, compared with hydrogen taken as unity. He called these numbers equivalents, out of habit, no doubt, for they are not really equivalents, as Gmelin well remarked in 1844 (*Handbuch*, 4th Ed., iv., 26). But in such a case as this, an error of language does not detract from the value of the ideas.

give rise to some important remarks. The proportion between the atomic weights of hydrogen, oxygen, nitrogen, chlorine, and carbon being the same in the two notations, it is evident, in the first place, that the formulæ of bodies containing these elements should be identical whenever they are represented by two volumes; in the second place, that the formulæ of Berzelius should be double Gerhardt's formulæ whenever the first represent four volumes. Thus, the formula by which Berzelius represented the composition of nitric acid is exactly double Gerhardt's formula.

It may be asked—why should the founder of atomic notation prefer these doubled formulæ corresponding to 4 volumes of vapour, to simple formulæ which would refer all volatile compounds, with few exceptions, to the same volume? He had good reasons for that. He considered that compound bodies were always formed by the addition of their elements, so that in any combination each of its ingredients occupied a distinct place. According to him, combinations might be more or less complicated, but they would always contain two elementary parts (either simple or compound) which would be in juxtaposition, and, as it were, opposed to one another. Chemical affinity would result from this opposition between two contrary forces always tending to neutralise each other; and these opposing forces which govern chemical combinations were of the nature of electricity. There are two electric fluids: every combination should therefore contain two halves—one electro-positive, the other electro-negative. Such is in a few words the system of Berzelius; the compound dualism of the electro-chemical theory.

It is now seen why Berzelius represented nitric acid by the formula N_2O_5,H_2O. In his view it was a combination of the second order, containing integrally all the elements of nitric acid on the one side, and all the elements of water on the other. The first constituted the electro-positive, the second the electro-negative element. To divide such a formula in half was to strike at the foundation of his system, for in the simplified formula there would neither be found the elements of water nor those of anhydrous nitric acid.

Again, nitrates would contain unchanged the elements both of nitric acid, and of the oxide, and if Berzelius had adopted half the atomic weights for the metals he would have written the nitrates N_2O_5,R_2O. His ideas would forbid him to simplify this or any analogous formula.

Modern chemistry has changed all that. The discovery of substitutions struck the first blow at the electro-chemical theory. This memorable discussion will long be remembered, in which a comparatively young chemist had the temerity to oppose his new theory in opposition to the one which had stood its ground for twenty years.

Chemists will recall that famous discussion in which Dumas proved conclusively that chlorine, an electro-negative element, could replace hydrogen, an electro-positive element; that chlorine could enter into organic molecules otherwise than by molecular addition. This was the commencement of the new chemistry.

Gerhardt commenced by saying:—"Combinations do not take place by molecular addition; everything is effected by substitution." The basis of this idea lies in an hypothesis formerly started by Ampère concerning the combination of chlorine with hydrogen. He regarded the formation of hydrochloric acid as due to a double decomposition. If, said he, 2 volumes of chlorine, representing 2 atoms, combine with 2 volumes of hydrogen, likewise representing 2 atoms, to form 4 volumes of hydrochloric acid, it is evident that 2 volumes of this acid should contain 1 volume or an atom of chlorine, and the 2 other volumes the other atom of chlorine; and the same in the case of the hydrogen. It is then evident that there has been a change between the atoms of hydrogen and of chlorine, that is to say, a double decomposition;

$$HH + ClCl = HCl + HCl.$$

M. Dumas expressed the same thing under another form when he said that in the combination of hydrogen and chlorine the *physical* atoms of these bodies divided in two.† M. Dumas termed physical atoms what Gerhardt designated by the name of molecules. One molecule of chlorine contains two atoms and corresponds with two volumes. Free chlorine, according to Gerhardt, is chloride of chlorine; free hydrogen is hydride of hydrogen. A molecule of hydrochloric acid (HCl) contains, therefore, as many atoms as a molecule of hydrogen (HH), and if a molecule of hydrocyanic acid is HCy, a molecule of cyanogen must be represented by CyCy. Free cyanogen is, therefore, cyanide of cyanogen.

Thus, not only do the molecules of compound bodies correspond to two volumes, but the molecules of simple bodies themselves are in the same case. In their molecular complication these latter approach the nature of compound bodies, except that the elementary atoms they contain are of the same kind. Simple bodies can therefore undergo double decomposition the same as compound bodies. In all chemical reactions it is the molecules which enter into collision and exchange their atoms in such a manner as to give rise to new molecules. When hydrogen combines with oxygen it attacks a molecule of oxygen, which being defeated, becomes converted into two molecules of water;

$$2HH + OO = H_2O + H_2O.$$

In the same manner, the combination of acids with bases depends upon double decomposition. When acetic acid combines with oxide of silver there is an exchange of elements between two molecules of acid and one molecule of oxide of silver: water and acetate of silver are formed by double decomposition;

$$2C_2H_4O_2 + Ag_2O = 2C_2(H_3Ag)O_2 + H_2O.$$

Thus acetate of silver does not contain, as Berzelius imagined, all the elements of a molecule of oxide of silver. It contains a single atom of silver, which is substituted for a single atom of hydrogen in a molecule of acetic acid.

Such are the ideas which are intimately connected with Gerhardt's system of atomic weights and notation, and which have led to a distinct separation between the notion of atoms and that of molecules.

An *atom* is the smallest quantity of an element, indivisible by chemical means, which can exist in a compound body.

A *molecule* is a group of atoms, forming the smallest quantity of a simple or compound body which can exist in a free state, or is able to take part in, or result from, a reaction.

(To be continued.)

On the Occurrence of Crystallised Melaconite in Cornwall, by A. H. Church.

Pure cupric oxide or melaconite is by no means of frequent occurrence. The volcanic variety of it, tenorite, is far from pure, while the earthy form, kupferswärze, often contains less than half its weight of cupric oxide. I examined, a few years ago, some earthy black copper

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† Dumas. *Philosophie Chimique.* 265.

from Cornwall. It was associated with cuprite, and contained only 6·27 per cent. of impurities, but no indications of crystals could be traced in it. Mr. Talling, however, has just forwarded to me for examination some beautiful crystals of melaconite, which quantitative analysis has proved to be remarkably pure. The specimens are from Cornwall. The crystals are brilliant, dark steel grey, opaque, and show a shining streak; they give a velvet black powder when finely ground. Their hardness is greater than that of calcite, less than that of fluor; their density is above 6. The cleanest and finest groups of crystals being reserved for measurement, the portion devoted to analysis was known to be mixed with a small proportion of gangue, but it nevertheless gave very satisfactory results. It should be stated that the mineral dissolves readily in warm hydrochloric acid, and that no cuprous salt could be detected in the solution. In another specimen a trace of cuprous chloride was found, but in that case a few minute crimson cubes of cuprite were seen under the microscope.

Analysis of Melaconite.

I. ·609 grm. gave ·475 grm. Cu (by Pfaff's method).
II. ·609 ,, ,, ·6005 ,, CuO
III. ·609 ,, ,, ·0105 ,, Gangue.

These results lead to the following mean percentages:

	I.	II.	III.
Cupric oxide. .	97·63	98·61	—
Gangue. . .	—	—	1·72

Deducting gangue, the theoretical and experimental percentages are as follows:—

	Theory, CuO.	Experiment I.	Experiment II.
Copper . .	79·75	79·35	100·33
Oxygen . .	20·25	(19·99)	
	100·00	99·34	

R. A. College, Cirencester, March 13.

*On the Theory of Types in Chemistry.**
by T. Sterry Hunt, *M.A., F.R.S.*

In the *Annalen der Chemie und Pharmacie* for March, 1860 (cxiii., 293), Mr. Kolbe has given a paper on the natural relations between mineral and organic compounds, considered as a scientific basis for a new classification of the latter. He objects to the four types admitted by Gerhardt—namely, hydrogen, hydrochloric acid, water, and ammonia—that they sustain to organic compounds only artificial and external relations, while he conceives that between these and certain other bodies there are natural relations having reference to the origin of the organic species. Starting from the fact that all the bodies of the carbon series found in the vegetable kingdom are derived from carbonic acid with the concurrence of water, he proceeds to show how all the compounds of carbon, hydrogen, and oxygen may be derived from the type of an oxide of carbon, which is either C_2O_4, C_2O_2, or the hypothetical C_2O.

When in the former we replace one atom of oxygen by one of hydrogen we have C_2O_3H, or anhydrous formic acid; the replacement of a second equivalent would yield $C_2O_2H_2$, or the unknown formic aldehyde; a third, C_2OH_3, the oxide of methyle; and a fourth, C_2H_4, or formene. By substituting methyle for one or more atoms of hydrogen in the previous formula, we obtain those of the corresponding bodies of the vinic series, and it will be readily seen that by introducing the higher alcoholic radicals we may derive from C_2O_4 the formulas of all the alcoholic series. A grave objection to this view is, however, found in the fact that while this compound may be made the type of the aldehydes, acetones, and hydrocarbons, it becomes necessary to assume the hypothetical C_2O_2,HO as the type of the acids and alcohols. Oxide of carbon, C_2O_2, is, according to Kolbe, to be received as the type of hydrocarbons, like olefiant gas (C_2HMe), while C_2O, in which ethyle replaces oxygen, is C_6H_5, or lipyle, the supposed triatomic base of glycerine.

The monobasic organic acids are thus derived from one atom of C_2O_4, while the bibasic acids, like the succinic, are by Kolbe deduced from a double molecule, C_4O_8, and tribasic acids, like the citric, from a triple molecule, C_6O_{12}. He moreover compares sulphuric acid to carbonic acid, and derives from it by substitution the various sulphuric organic compounds. Ammonia, arseniuretted, and phosphuretted hydrogen are regarded as so many types; and by an extension of his view of the replacement of oxygen by electro-positive groups, the ethylids $ZnEt$, $PbEt_2$, and $BiEt_3$, are by Kolbe assimilated to the oxides of ZnO, PbO_2, and BiO_3.

Ad. Wurtz, in the *Repertoire de Chimie Pure* for October, 1860, has given an analysis of Kolbe's memoir (to which, not having the original before me, I am indebted for the preceding sketch), and follows it by a judicious criticism. While Kolbe adopts as types a number of mineral species, including the oxides of carbon, of sulphur, and the metals, Wurtz would maintain but three, hydrogen (H_2), water (H_2O_2), and ammonia (NH_3); and these three types, as he endeavoured to show in 1855, represent different degrees of condensation of matter. The molecule of hydrogen, H_2 (M_2), corrresponding to four volumes, combines with two volumes of oxygen (O_2) to form four volumes of water, and may thus be regarded as condensed to one-half in its union with oxygen, and derived from a double molecule, M_2M_2. In like manner four volumes of ammonia contain two volumes of nitrogen and six of hydrogen, which, being reduced to one-third, correspond to a triple molecule, M_2M_3, so that these three types and their multiples are reducible to that of hydrogen more or less condensed.—(Wurtz, *Annales de Chimie et de Physique* (3) xliv. 304.

As regards the rejection of water as a type of organic compounds, and the substitution of carbonic acid, founded upon the consideration that these in nature are derived from C_2O_4, Wurtz has well remarked that water, as the source of hydrogen, is equally essential to their formation, and, indeed, that the carbonic anhydrid C_2O_4, like all other anhydrous acids, may be regarded as a simple derivative of the water type. Having, then, adopted the notion of referring a great variety of bodies to a mineral species of simple constitution, water is to be preferred to carbonic anhydrid, first, because we can compare with it many mineral compounds which can with difficulty be compared with carbonic acid; and secondly, because the two atoms of water being replaceable singly, the mode of derivation of a great number of compounds (acids, alcohols, ethers, &c.) is much more simple and natural than from carbonic acid. As Wurtz happily remarks, Kolbe has so fully adopted the theory of types that he wishes to multiply them, and even admits condensed types, which are, however, molecules of carbonic acid, and not of water; "he combats the types of Gerhardt, and at the same time counterfeits them."

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* We willingly reprint this article at the request of the learned author, who is reasonably anxious that his own share in the development of the ideas now generally received should not be overlooked.—Ed. C.N.

Thus far we are in accordance with Mr. Wurtz, who has shown himself one of the ablest and most intelligent expounders of this doctrine of molecular types, as above defined, now almost universally adopted by chemists. He writes:—"To my mind this idea of referring to water, taken as a type, a very great number of compounds, is one of the most beautiful conceptions of modern chemistry."—(*Repertoire de Chimie Pure*, 1860, p. 359); and again, he declares the idea of regarding both water and ammonia as representatives of the hydrogen type, more or less condensed, to be so simple and so general in its application that it is worthy "to form the basis of a system of chemistry."—(*Ibid.*, p. 356.)

We have in this theory two important conceptions: the first is that of hydrogen and water regarded as types to which both mineral and organic compounds may be referred; and the second is the notion of condensed and derived types, according to which we not only assume two or three molecules of hydrogen or water as typical forms, but even look on water as the derivative of hydrogen, which is itself the primal type.

As to the history of these ideas, Wurtz remarks that the proposition enunciated by Kolbe that all organic bodies are derived by substitution from mineral compounds is not new, but known in the science for about ten years. "Williamson was the first who said that alcohol, ether, and acetic acid were comparable to water—organic waters. Hofmann and myself had already compared the compound ammonias to ammonia itself." . . . "To Gerhardt belongs the merit of generalising these ideas, of developing them, and supporting them with his beautiful discovery of anhydrous monobasic acids. Although he did not introduce into the science the idea of types, which belongs to M. Dumas, he gave it a new form, which is expressed and essentially reproduced by the proposition of Kolbe. Gerhardt reduced all organic bodies to four types—hydrogen, hydrochloric acid, water, and ammonia."—(*Ibid*, p. 355.)

The historical inaccuracies of the above quotation are the more surprising since in March, 1854, I published in the *American Journal of Science*, (xvii., 194) a concise account of the progress of these views. This paper was re-published in the *Chemical Gazette* (1854, p. 181), and copies of it were by myself placed in the hands of most of the distinguished chemists of England, France, and Germany. In this paper I have shown that the germ of the idea of mineral types is to be found in an essay of Auguste Laurent (*Sur les Combinaisons Azotées*, *Ann. de Chimie et Physique*, Nov., 1860), where he showed that alcohol may be looked upon as water (H_2O_2) in which ethyle replaces one atom of hydrogen, and hydric ether as the result of a complete substitution of the hydrogen by a second atom of ethyle. Hence he observed that while ether is neutral, alcohol is monobasic, and the type of the monobasic vinic acids, as water is the type of bibasic acids. In extending and developing this idea of Laurent's, I insisted in March, 1848, and again in January, 1850, upon the relation between the alcohols and water as one of homology, water being the first term in the series, and H_2 being in like manner the homologue of acetene and formene, while the bases of Wurtz were said to "sustain to their corresponding alcohols the same relation that ammonia does to water."—(*Am. Jour. Sci.*, v., 265; ix., 65; xiii., 206.)

In a notice of his essay, published in September, 1848, (Ibid, vi., 173) I endeavoured to show that Laurent's view might be farther extended, so as to include in the type of water "all those saline combinations (acids) which contain oxygen;" and in a paper read before the American Association for the Advancement of Science at Philadelphia, in September, 1848, I further suggested that as many neutral oxygenised compounds which do not possess a saline character are derivatives of acids which are referable to the type H_2O_2, "we may regard all oxygenised bodies as belonging to this type," which I further showed in the same essay is but a derivative of the primal type H_2, to which I referred all hydrocarbons and their chlorinised derivatives, as also the volatile alkaloids, which were regarded "as amidised species" of the hydrocarbons, in which the residue amidogen, NH_2, replaced an atom of H or Cl, or, what is equivalent, the residue NH was substituted for O_2 in the corresponding alcohols. (Ibid viii., 92).

In the paper published in September, 1848, I showed that while water is bibasic, the acids which like hypochlorous and nitric acids were derived from it by a simple substitution of Cl and NO_4 for H, were necessarily monobasic, and I then pointed out the possible existence of the nitric anhydride $(NO_4))_2O_2$, which was soon after discovered by Deville. Gerhardt at this time denied the existence of anhydrides of the monobasic acids, while he regarded anhydrides as characteristic of polybasic acids, and, indeed, was only led to adopt my views by the discovery of the very anhydrides whose formation I had foreseen.†

In explaining the origin of bibasic acids I described them as produced by the replacement, in a second equivalent of water, of an atom of hydrogen by a monobasic saline group; thus sulphuric acid would be $(S_2HO_6H)O_2$. Tribasic acids in like manner are to be regarded as derived from a third equivalent of water in which a bibasic residue replaces an atom of hydrogen. The idea of polymeric types was further illustrated in the same paper, where three hydrogen types were proposed (HH) (H_2H_2) and (H_3H_3) corresponding to the chlorides MCl, MCl_2 and MCl_3. It was also illustrated by sulphur in its ordinary state, which I showed is to be regarded as a triple molecule S_3 (or $S_6 = 4$ volumes) and referred sulphurous acid SO_2 to this type, to which also probably belongs selenic oxide. (At the same time I suggested that the odorant form of oxygen or ozone was possibly O_3.) Wurtz in his memoir, published in 1855, adopts my view, and makes sulphur vapour at 400° C. the type of the triple molecule. I further suggested (*American Journal of Science*, v. 408, vi. 172,) that gaseous nitrogen is NN, an anhydride amide or nitryl, corresponding to nitrite of ammonia, $(NO_3,NH_4O)-H_4O_4=NN$. This view a late writer attributes to Gerhardt, who adopted it from me (*Ann. der Chimie et Phys.*, lx. 381). May not nitrogen gas, as I have elsewhere suggested, regenerate under certain conditions, ammonia and a nitrite, and thus explain not only the frequent formation of ammonia in presence of air and reducing agents, but certain cases of nitrification?‡

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† The anhydrides of the monobasic acids correspond to two equivalents of the acid, minus one of water, as,—

$$2(C_2H_4O_4)-H_2O_2=C_8H_6O_6,$$

while one equivalent of a bibasic acid (itself derived from $2(H_2O_2)$) loses one of water, an anhydride, as—$C_8H_2O_8-H_2O_2=C_8O_6$. So that both classes of anhydrides are to be referred to the type of one molecule of water, H_2O_2.

‡ The formation of a nitrite in the experiments of Cloez appears to be independent of the presence of ammonia, and to require only the elements of air and water (*Comptes Rendus*). Some experiments now in progress lead me to conclude that the appearance of a nitrite in the various processes for ozone, is due to the power of nascent oxygen to destroy by oxidation the ammonia generated by the action of water on nitrogen, the nitrous nitryl; so that the odour and many of the reactions assigned to ozone or nascent oxygen are really due to the nitrous acid which is set free when the former encounters nitrogen and moisture. On the other hand, nascent hydrogen, which readily reduces nitrates and nitrites to ammonia, by destroying the regenerated nitrite of the nitryl, produces ammonia in many cases from atmospheric nitrogen.

I endeavoured still further to show that hydrogen is to be looked upon as the fundamental type from which the water type is derived by the replacement of an atom of H by the residue HO_2 (*American Journal*, viii., 93.) In the same way I regarded ammonia as water in which the residue NH replaced O_2.

I have always protested against the view which regards the so-called rational formulæ as expressing in any way the real structure of the bodies which are thus represented. These formulæ are invented to explain a certain class of reactions, and we may construct from other points of view other rational formulæ which are equally admissible. As I have elsewhere said, "the various hypotheses of copulates and radicals are based upon the notion of dualism, which has no other foundation than the observed order of generation, and can have no place in a theory of science." All chemical changes are reducible to union (identification), and division (differentiation). When in these changes only one species is concerned, we designate the process as metamorphosis, which is either by condensation or by expansion (homogeneous differentiation). In metagenesis, on the contrary, unlike species may unite, and by a subsequent heterogeneous differentiation give rise to new species, constituting what is called double decomposition, the results of which, differently interpreted, have given origin to the hypothesis of radicals and the notion of substitution by residues to express the relations between the parent bodies and their progeny. The chemical history of bodies is, then, a record of their changes. It is, in fact, their genealogy, and in making use of typical formulæ to indicate the derivation of chemical species we should endeavour to show the ordinary modes of their generation. (See "On the Theory of Chemical Changes," *Am. Jour. Sci.* xv. 226, L. E. and D. *Phil. Mag.* (4) v. 526, and *Chem. Centralblatt*, 1853, p. 849. Also "Thoughts on Solution," *Am. Jour. Sci.*, xix. 100, and *Chemical Gazette*, 1855, p. 92.)

(To be continued.)

On the Solubility of the Sulphate of Baryta in Sulphuric Acid, by Professor J. NICKLES.

THE sulphates of baryta, strontia, and lime, are slightly soluble, as is known, in boiling sulphuric acid. I have found that they are soluble in cold acid when in a nascent state.

To obtain this result it is only necessary to throw a little chloride of barium or of strontium into a sufficient quantity of mono-hydrated acid; the chloride is by degrees decomposed, chlorhydric acid escapes, and the sulphate produced dissolves in the surrounding acid.

This is especially true for the chloride of barium; but to succeed the acid should be concentrated, and it is best to have the chloride well dried and in powder. On adding water to the solution thus obtained, the sulphate of baryta falls as a white precipitate.

The chloride of strontium gives the same results, and the acid solution affords a similar precipitate with water, though less in amount since less is dissolved.

The sulphate of lime is still less soluble in sulphuric acid, and the solution takes several days to become limpid. Moreover, water does not then becloud it. A light precipitate is obtained with alcohol.

The solubility of the sulphates in sulphuric acid is then the reverse of their solubility in water, except for the sulphate of strontium, which, in both cases, is a mean between those of the other two.—*Ann. Jour. Science and Arts*, Vol. xxxix., No. 115.

On the Separation of Cobalt from Nickel, by WOLCOTT GIBBS, *M.D.*

A METHOD of separating these metals, given some years since by Liebig,[*] consists in boiling the mixed double cyanides of nickel and potassium and cobalt and potassium with oxide of mercury. Oxide of nickel is precipitated while an equivalent quantity of mercury is dissolved as cyanide. The method certainly gives good results, but is not free from objection. Long boiling is necessary before the precipitation is complete, and it is difficult to prevent bumping during ebullition. The excess of oxide of mercury must be separated from the oxide of nickel by a special operation, and the nickel afterwards again precipitated by caustic alkali.

These inconveniences may be completely avoided by employing, instead of the oxide alone, a solution of the oxide in the cyanide of mercury. When this solution is added to a hot solution of the double cyanide of nickel and potassium, the whole of the nickel is immediately thrown down as a pale green hydrate of the protoxide. Under the same circumstances cobalt is not precipitated from the double cyanide of cobalt and potassium. Mr. W. N. Hill, who has repeatedly employed this method and carefully tested it, has found that the separation effected is complete. No cobalt can be detected in the precipitated oxide of nickel by the blowpipe, nor can the nickel be detected in the cobalt (finally separated as oxide) by Plattner's process with the gold bead. The solution of oxide of mercury is easily obtained by boiling the oxide with a strong solution of the cyanide, and filtering. According to Kuhn,[†] the cyanide formed in this manner has the formula $HgCy+3HgO$. The hydrated oxide of nickel precipitated may be filtered off, washed, dried, ignited, and weighed. The cobalt is more readily and conveniently determined by difference, when, as it is always possible, the two metals have been weighed together as sulphates. I am not prepared to say that this modification of Liebig's method of separating nickel and cobalt gives better results than Stromeyer's process by means of nitrite of potassium, but it is at least very much more convenient, and requires much less time. The complete precipitation of cobalt in the form of $CO_2O_3,2NO_3+3KONO_3$ usually requires at least forty-eight hours, and rarely succeeds perfectly except in experienced hands.—*American Journal of Science and Art*, January, 1865.

On Catechine,[‡] *by MM.* KRAUT *and Van* DELDEN.

THE authors in the first place confirm the composition which M. Neubauer deduced from his analyses of catechine, and they agree with him in admitting that it is not a glucoside. After being dried at 100° in a current of hydrogen gas its formula is $C_{24}H_{12}O_{10}$.

A boiling solution of catechine in alcohol, traversed by a current of hydrogen, saturated with hydrochloric gas, forms, in about two hours, a mass of crystals constituting catechuretine, which dried in the air gives the composition $26_{24}H_{10}O_8+7HO$. At 100° in a current of hydrogen, it loses 14·51 per cent. of water; theoretically it should be 12·6.

With bromine water catechine gives bromated catechuretine $C_{24}Br_4H_6O_8$. According to the above, catechuretine would be an isomer of piperic acid.

MM. Schutzenberger and Rack have recently arrived at almost identical results, and at the same time they made known some new derivatives, such as benzoate of catechine.

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[*] *Ann. der Chemie und der Pharmacie*, lxv., 244.

[†] Berzelius, "Lehrbuch der Chemie," iii., 872.

[‡] *Ann. hem. Pharm.*, lii., 285.

Purification of Rough Paraffine,[*] *by M.* Kletzinsky. Crude paraffine contaminated with various empyreumatic oils is refined and purified by various processes, either by means of the centrifrugal machine or by sulphuric acid. Various attempts to discover some simpler means of refining have led to the two following processes:—

About 10 per cent. of powdered hypochlorite of lime is incorporated with the crude melted paraffine; the mass becomes white and disengages oxygen. Pour it into some diluted hydrochloric acid, and boil the whole until all the paraffine rises to the surface.

The second process consists in heating the rough paraffine with ten times its volume of amylic alcohol, and filtering while hot. The tar-like matter remains on the filter, the oils remain in solution while the pure paraffine separates on cooling. It is then in the form of nacreous flakes, and is pressed, triturated once or twice with cold amylic alcohol, again pressed, washed with amylic alcohol, and melted. The product constitutes pure paraffine.

Note on Chrome Alum, by George Gatheral.

The conversion of violet-chrome alum into the green uncrystallisable variety by the action of heat is well known, but the following observation of the change from the green to the violet form by exposure to cold, is, I believe, new:—A large quantity of chrome alum having been made at the Mechanics' Institution Laboratory, the various mother liquors were boiled up to a syrupy consistence, placed in a bottle and laid aside.

The solution had a pure and intense green colour and retained its fluidity for several months. After exposure for several days to rather intense cold, however, the bottle was observed to be full of a solid body, consisting of minute crystals of ordinary violet-chrome alum. Upon dissolving in tepid water, crystallising and evaporating the mother liquor, nearly the whole of the alum was obtained in crystals. A dilute solution of green-chrome alum, prepared about a year since, has also become changed in great part, but whether the conversion has been gradual, or whether it occurred during the late cold weather, I am unable to say.

Glasgow, March 7, 1865.

On the Colouring Matter of Fustic,[†] *by MM.* Bolley *and* Mylius.

Fustic, called also Hungarian fustic, is the wood of the *Rhus cotinus* freed from sap and bark, and is imported from Dalmatia, Hungary, Illyria, the south of the Tyrol, and from Spain, in the form of short knotty blocks.

It is used almost in the same way as ordinary fustic (*morus tinctoria*), though the decoctions of these two coloured woods present remarkably different reactions.

M. Chevreul, who has been almost alone in his chemical researches on fustic, found in it—1. A yellow colouring matter, presenting itself when pure in the form of small crystalline needles, and which he called fissetine, or fisetic acid; 2. A red substance, of which he is unable to decide whether it pre-exists in fustic, or whether it is only the result of an alteration of the fissetine.

By treating solid extract of fustic (obtained by evaporating its aqueous decoction) by concentrated alcohol, there finally remains a residue, which dissolves with a red brown colour in water. MM. Bolley and Mylius have not yet examined this residue, which contains the red colouring matter.

The alcoholic solution furnishes, after concentration by the addition of water, a yellow crystalline precipitate. This same precipitate may frequently be found at the bottom of vessels in which aqueous extract of fustic has been kept for some time.

By washing it in cold water, collecting on a filter, pressing, and dissolving it in alcohol, then precipitating by water, and repeating this operation, it may easily be seen that the yellow crystalline substance thus obtained, and which precipitates acetate of lead of an orange red colour, is really quercetine.

TECHNICAL CHEMISTRY.

Results of the Experiments on the Carburation of Coal Gas, by H. Letheby, *M.B., M.A., Ph.D., &c., Medical Officer of Health and Gas Analyst for the City of London.*

The experiments made, during the last two years, on the carburation of gas at the street lamps, have developed a number of facts that should be placed on record, for these facts are not merely of scientific interest, they are also of practical value.

A common notion prevails that the use of the carburettors in the public lamps has not been successful. I have, therefore, made it my business to ascertain whether this notion is founded on fact, and if so, whether the failure is due to an imperfection in the principle of the process, or to the manner in which it has been applied.

On the first of these heads it is necessary only to say that, while, on the one hand, it cannot be denied that the use of the carburettors has not given public satisfaction, so, on the other, it must be admitted that, although the process has not been fairly applied, its want of success is by no means so great as is generally supposed.

The principle involved in the process is, beyond all question, a correct principle, in so far as it relates in its application to the very inferior gas of London; but the success of the process is dependent on certain conditions which have not always been fulfilled. It has been ascertained, in fact, that the results of the process are affected by a great number of circumstances, many of which have been either disregarded, or have been placed beyond our control. These circumstances are— the quality of the naphtha, the time of the experiment, the temperature of the apparatus, the form of the carburettor, the quality of the gas, and the rate at which it traverses the instrument. All these circumstances have received attention, and the following are the results of it:—

1. **As Regards the Quality of the Naphtha.**— This has a very marked influence on the illuminating power of the naphthalised gas. In point of fact, I have ascertained, by experiment, not only that the different naphthas of commerce furnish different proportions of vapour to the gas, according to their different degrees of volatility, but, also, that those vapours are endowed with very different degrees of photogenic power. A single grain, for instance, of some of the hydrocarbons to each cubic foot of common gas will raise its illuminating power to the extent of only about 1·69 per cent.; whereas a grain of other hydrocarbons will raise it nearly 9 per cent. This is illus-

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[*] *Polyt. Notizbl.* p. 350. 64.

[†] Schweiz, *Polyt. Zeitschr*, ix. 22. 64.

trated by the following table, where only a few of very many experiments are recorded :—

Table of the specific gravity, boiling point, volatility, and illuminating power of the various Naphthas used in a common street carburettor, with a batswing burner consuming three feet of Gas per hour.

Specific gravity, water being 1000.	Boiling point (Centigrade). (deg.)	Amount per cent. yielded by distillation.		Average quantity taken up by each foot of gas. (grains.)	Per centage increase of illuminating power.	
		Up to 130° Cent. (grains.)	From 130° to 150° Cent. (grains.)		Total.	For each grain of Naphtha per cubic foot.
698	63	86	14	20·1	33·9	1·69
676	40	98	2	34·4	62·1	1·80
869	102	76	22	12·1	40·8	3·37
827	115	56	40	6·5	21·7	3·43
808	117	27	53	6·1	21·0	3·60
852	128	4	51	3·8	14·2	3·72
869	107	75	19	9·2	34·9	3·79
869	103	83	14	11·8	46·8	3·96
816	119	15	45	3·4	14·4	4·23
856	114	23	49	4·4	18·9	4·29
814	105	60	34	7·0	33·5	4·78
865	124	9	34	3·3	15·8	4·79
845	90	92	8	12·0	65·3	5·44
874	119	45	37	4·8	26·7	5·56
879	93	92	8	9·5	53·2	5.60
870	129	5	44	2·8	15·7	5·61
862	121	10	45	3·3	20·4	6·16
848	97	77	15	10·2	68·4	6·70
861	117	24	29	2·3	18·8	8·17
875	110	75	20	6·9	60·8	8·81

It would seem from this, that a naphtha with a low specific gravity, and a low boiling point, is not well suited for the carburation of gas; for, although it yields a large quantity of vapour to the gas, the photogenic value of it is but small. This is the kind of naphtha obtained from the petroleums and shales of commerce, and it has not unfrequently been found in the naphthas supplied to the public lamps. On the other hand, the naphthas obtained from coal tar are much richer in carbon, and are, therefore, better suited for the carburation of gas. But the more volatile of these naphthas are so largely used in the manufacture of red and purple dyes, that it is difficult to obtain them, at a reasonable price, for the street carburettors. I have, therefore, been compelled to specify a quality of naphtha which is not well fitted for the manufacture of dyes; but this, also, is of rather low volatility, and is, therefore, not so good for the carburation of gas as it ought to be. The terms of the specification are, "that the naphtha shall be colourless; of a specific gravity of about 870; of a boiling point not higher than 110° C. (230° Fahr.); and yielding, on distillation, at least 70 per cent. of volatile naphtha, between the boiling point and 130° C. (266° Fahr.); and 20 per cent. between 130° and 150° C. (266° and 300° Fahr.)." This naphtha (the last in the table) furnishes about 7 gr. of hydrocarbon vapour to each cubic foot of gas, at ordinary temperatures, and it raises the illuminating power of the gas about 60 per cent.; in other words, it increases the light of a three-foot batswing burner from about seven candles to eleven, and thus makes three feet of gas of the same value as 4·8. If it were possible to obtain, at a reasonable price, a coal naphtha of a little higher volatility at ordinary temperatures—as, for example, a naphtha yielding about ten grains of hydrocarbon to each cubic foot of gas,—the illuminating power of the gas would be increased about 68 per cent. A gallon of this naphtha will weigh nearly 60,000 grains, and it would be sufficient to naphthalise 6000 cubic feet of gas—making them equal to about 10,000 feet of unnaphthalised gas. Such a naphtha, even at 6s. per gallon, would be equal to just three times its money worth of gas; for a gallon of the naphtha, costing 6s., would give the light of 4000 cubic feet of gas, costing 18s. The only difficulty, at present, in the realisation of this object is, in the uncertain composition of the naphthas of commerce; but this difficulty would soon be overcome if a steady demand for such a naphtha existed. Even as it is, it may be said that the common coal naphthas of commerce increase the illuminating power of the London gas to the extent of about 4·5 per cent. for every grain of naphtha taken up by a cubic foot of gas. These naphthas are obtained at a maximum price of 4s. per gallon, and a gallon will double the illuminating power of rather more than 2600 cubic feet of gas; in other words, we have 4s. worth of naphtha doing the work of about 12s. worth of gas. These are the unquestionable results, not merely of laboratory investigations, but also of carefully conducted experiments at the public lamps in Moorgate Street.

2. As Regards the Time, or Duration, of the Experiment.—As all the naphthas of commerce are mixtures of various hydrocarbons of different degrees of volatility, it happens that the most volatile constituents of the naphthas are given up, very freely, to the gas at the commencement of the experiment, and the less volatile, with more difficulty, at the end. In consequence of this, there is always a large increase of illuminating power when the carburettor is first charged with naphtha, and a marked diminution of it at last. This irregularity has not, hitherto, been compensated for by a regulated supply of gas; and, therefore, it has happened, that when a naphtha yielding, at first, as much as twenty-three grains of hydrocarbon per cubic foot of gas has been used, the illuminating power has been doubled; but, after a time, from the diminished volatility of the naphtha, the power has gradually fallen to less than 25 per cent. Numerous experiments have been made to determine the influence of this circumstance on the value of the process, and the following table is given in illustration of it:—

*Table showing the differences in the volatility of the Naphtha, and the illuminating power of the Gas, at different periods of the experiments.**

Quantity of gas passed. (cubic feet.)	Quantity of naphtha taken up per foot of gas. (grains.)	Illuminating power, in standard sperm candles.		
		Not carburetted.	Carburetted.	Increase per cent.
80	23·2	6·78	13·68	101·7
152	21·6	7·42	14·30	92·8
136	17·6	7·45	13·24	75·1
232	15·6	7·25	12·10	67·0
198	11·6	6·80	10·19	50·0
249	11·5	7·04	10·44	48·3
285	11·5	7·17	10·81	50·1
330	7·4	7·62	10·04	31·8
451	7·3	7·18	9·60	33·7
2113	12·1	7·21	11·60	60·1

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* This experiment was made with a street carburettor of the form designed by me, and with 26,000 grains, or nearly four pints, of common naphtha, having a density of 869°, and a boiling point of 103° C, and yielding 82·7 per cent. of distilled product from its boiling point to 130° C., and 14·3 per cent. from 130° to 150° C. The experiment was continued for thirty days and nights, and the gas was continually burning from a three-foot batswing burner, the temperature of the room being 22° C. (72° F.)

3. **The Influence of Temperature on the Carburation of the Gas.**—In warm weather the volatility of the naphtha is increased, and, therefore, a larger amount of hydro-carbon vapour is given to the gas. A few experiments have been made, at different times of the year, on the street carburettors, with the view of ascertaining the extent of this influence within common ranges of temperature. The following are the results:—

Table showing the volatility of the Naphtha, and percentage amounts of increase of illuminating power, according to temperature, at different seasons of the year.

Season.	Temperature, Fahrenheit.	Quantity of naphtha per cubic foot of gas (grains).	Per centage increase of illuminating power.
Spring . .	41°	5·25	23·6
Summer . .	72°	12·09	54·4
Autumn . .	62°	10·77	48·5
Winter . .	37°	4·94	22·2

These results show that it is of great importance to keep the carburettors at as uniform a temperature as possible; and it is with this view that the Carburetting Company have placed the apparatus within the lamps, thinking that, in such a situation, a common and uniform temperature of about 60° would be maintained. There is, however, a better situation at the top of the lamp, where the temperature, at the time of carburation, would be very uniform at all seasons of the year, and where the apparatus would be entirely out of sight.

4. **As Regards the Form of the Apparatus.**—Experiment has proved that the form of the apparatus has a very marked influence on the carburation of the gas; for when the instrument is so constructed that the gas merely passes into the chamber containing the naphtha, without sweeping over the surface of the liquid, a very small proportion of the volatile hydrocarbon is taken up. On the contrary, when the gas is brought into contact with a large surface of naphtha, it becomes highly charged with the vapour, and acquires a high illuminating power. In the course of the experiments which have been made for the purpose of estimating the value of this influence, four kinds of carburettors have been used, namely:—

1. A simple chamber, containing naphtha, with an inlet and exit pipe for the gas at the apex of the apparatus.
2. The carburettor supplied by the Carburating Company, which is contrived to make the gas flow once over the surface of naphtha before it leaves the chamber.
3. A carburettor contrived by me, which has a series of septa for making the gas pass many times over the naphtha before it leaves the opparatus.
4. A carburettor of M. Mongruel, and also one of M. Nordhoff, both of which contain septa of cotton threads, saturated with naphtha, through which the gas must pass, and so become highly charged with vapour before it leaves the chamber.

In operating with each of these carburettors, under the same circumstances, and with the same naphtha—namely, that supplied according to the contract, it was found, that while the first form of apparatus gave only 3·2 grains of naphtha per cubic foot of gas, the second gave 6·0 grains, the third 12·1 grains, and the fourth from 22 to 23 grains. It is manifest, therefore, that to secure a uniform supply of hydrocarbon vapour, it is necessary to bring the gas into contact with a large surface of naphtha.

5. **The Quality of the Gas Affects the Carburation.**—When gas is already charged with a large proportion of the richer hydrocarbons, it manifests no disposition to take up the vapour of naphtha—on the contrary, if it be a cannel gas of very high illuminating power, the naphtha will deprive it, to a certain extent of its hydrocarbons, and so render it weaker,—the process, therefore, is only applicable to such a poor gas as that which is supplied to the City; and, even in the case of this gas, it has been noticed that when a dose of naphtha has been already given to it, it does not show the same tendency to absorb the vapour as it did before.

6. **The Carburation of the Gas is Affected by the Rate at which it Traverses the Apparatus.**—This might be easily perceived from the circumstance that the longer and more completely the gas is brought into contact with the naphtha, the more fully it becomes charged with its vapour. Experiment has shown that when in the same carburettor the gas is burnt at the rate of 3 feet per hour, and the light is increased to the extent of 41 per cent., it will be only increased to 34 per cent. if it is burnt at the rate of 3½ feet per hour; but this difficulty is easily overcome by increasing the surface of naphtha.

In conclusion, therefore, it may be said, that although the success of the carburetting process is evidently dependent on many conditions, yet, as all these conditions are under control, there is no reason that they should not be at all times fulfilled, and the success of the process secured. One thing, it will be observed, is beyond all question, and that is, that every grain of common coal naphtha given to a cubic foot of gas increases its illuminating power about 4·5 per cent. (a good naphtha will increase it about 8 per cent.); and this grain of naphtha costs only about one-third of its equivalent in London gas.

Acetone in the Manufacture of Varnish,[*] *by M. le Dr.* WIEDERHOLD.

According to M. Wiederhold, acetone rendered anhydrous by rectification over chloride of calcium readily dissolves cold copal which has been previously heated to the point of fusion. Only 2·8 of acetone are required for 1 of copal, and a copal varnish is thus obtained, which dries almost instantaneously, leaving a hard, brilliant, and durable coating. A more concentrated and almost syrupy solution is obtained, without separating any copal, by expelling part of the acetone by distillation. Evaporated to dryness, the remaining copal is more soluble in acetone than when in its original state. The solubility of gum lac in acetone varies according to the species of the gum; 1 part of artificially bleached gum lac required only 1·5 of acetone to form a thick solution like syrup, another, a coloured specimen of gum lac, was almost insoluble, and a third required 3·5 times its weight of acetone to dissolve it.

Acetone dissolves with especial facility, and in considerable quantities mastic and sandarach; dammar, yellow amber, and india-rubber are, on the contrary, almost insoluble. The solution of acetone and mastic produces a very beautiful and brilliant varnish. M. Wiederhold is of opinion that acetone might be employed for the restoration of oil paintings deteriorated by the alteration of the varnish, which often becomes opaque from the effect of a molecular modification, and which, from a vitreous and transparent state, becomes crystalline or pulverulent. By carefully applying acetone the opaque varnish may be momentarily dissolved, and will then redispose itself, but in a vitreous state.

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[*] Dingler *Polyt. Journ.*, clxxii., 460. 64.

PROCEEDINGS OF SOCIETIES.

ACADEMY OF SCIENCES.

March 6, 1865.

M. Chevreul read a second section of his historical "*Note on the Various Opinions which have been held on the Composition of the Atmosphere.*" In this section he reviewed the opinions of Stahl and others. It would be curious to know what has stimulated the learned academician to treat or bore his brethren with this *rechauffé* of papers he published some years ago.

M. Faye communicated a letter he had received from Father Secchi, "*On the Constitution of the Sun,*" and made some additional remarks of his own, in which he quoted the experiments of Mr. Huggins on the spectra of the nebulæ in support of his opinions on the physical constitution of the sun. We shall give an outline of these in connection with the last communication of Mr. Huggins to the Astronomical Society on the spectrum of the great Nebula in Orion.

A memoir by Vice-Admiral Coupvent de Bois was read "*On the Horary Variations of the Barometer.*" It has already been shown that on continents the variations of the barometer go on diminishing from the equator towards the poles. The Admiral shows from observations made during a long voyage that the same variations were remarked at sea until he reached the latitude 60° south, where the horary variations became almost insensible.

M. Nicklés presented a memoir "*On the Existence of Bichlorides of Manganese, and similar Iodine and Bromine Compounds.*" By treating peroxide of manganese with hydrochloric acid, we obtain chlorine and chloride of manganese, and the books explain that half the chlorine is given off because a bichloride of manganese corresponding to the binoxide does not exist. The author, however, shows that such a compound may be formed. Having seen before that water decomposes certain perchlorides, perbromides, &c., while ether renders them stable, he made experiments in this direction, and discovered that a perchloride of manganese might be formed in two ways, either by passing a current of dry chlorine upon the protochloride held in suspension in ether or alcohol, or by acting on the peroxide by hydrochloric acid in the presence of these liquids. The latter process gave the best results. It succeeds in any case; but it is well to keep the vessel containing the oxide and ether well cooled. The product is of a green colour, and is very unstable, and quickly gives off chlorhydric gas. Though soluble in all proportions in ether, it is insoluble in sulphide of carbon. Phosphorus decolorises the solution, forming protochloride of manganese, as also do iron filings, and zinc, and antimony in powder. Perbromide and periodide of manganese may be obtained in a similar way. They are all deep-green coloured compounds. So also are the compounds given by Mn_2O_3 with hydrochloric, hydrobromic, or hydriodic acid gas in ether or anhydrous alcohol. The ether compounds appear more stable than those obtained with alcohol. The author foresees the possibility of procuring many haloid compounds not yet obtainable, and dreams, he says, of obtaining chloro-arsenic acid, $AsCl_5$, which defeated all the attempts of Rose.

M. Deville communicated a letter of M. Berthelot "*On the Calorific Phenomena which Accompany the Formation of Organic Compounds.*" This letter is the first of a series promised by the author, and seem to us of sufficient importance to demand full translation. In his present letter the author deals with the carbides of hydrogen and alcohol.

M. Renault communicated "*A New Method of Quantitative Analysis Applicable to Alloys.*" This is a physical experiment in which the amounts of metals are calculated from the quantity of electricity furnished by their solution in acids. The idea is very ingenious; but the author confesses that the results are never so accurate as those daily obtained by the ordinary methods, so we may pass it over.

M. Elie de Beaumont presented a note by Signor Sismonda "*On a Specimen of Gneiss bearing the Imprint of an Equisetum.*" The author believes in the metamorphic origin of Alpine gneiss, and draws important consequences as to the age of plants. He thinks that in special cases, and notwithstanding geological catastrophes, the existence of the plants in some localities under climatic conditions was prolonged beyond the carboniferous period. Fancy the Alps an island washed by the gulf-stream, and we have all the conditions necessary. This discovery of Signor Sismonda was referred to by Professor Ramsay in his lecture on the Eozoon at the Royal Institution last Friday.

NOTICES OF BOOKS.

Report on the Air of Mines and Confined Places. By Angus Smith, Ph.D., F.R.S. Part of the Appendix to the Royal Mines Commission. 1864.

The Government of a wealthy country is specially interested in promoting the health of the producers of wealth. The individual employer who knows of nothing but the "cash nexus" between himself and his *employés* is simply anxious to get his work done. If some men die he knows that others come for their places, and that is enough for him. A Government must needs take a wider view of the matter. It sees in shortened and diseased lives a serious diminution of national wealth which springs from labour alone; and beyond this, in the same spirit as it provides for the defence of a citizen from personal assaults, it feels (or should feel) it a duty to defend him from more insidious and dangerous attacks on his life. With this view various laws have been passed for the protection of classes who are placed in circumstances under which they cannot protect themselves. We need not instance these laws; but we may say that miners have, to some extent, shared the protection they afford.

The ventilation of mines is a matter which has received much attention; but hitherto the great object of care has been to prevent the accumulation of fire-damp. The air which the miner breathes, and which, in process of time, may be as fatal to him as an explosion of fire-damp, has been but little thought of. Considerable importance was attached to this subject by some of the members of the last Royal Commission; and Dr. Angus Smith was instructed to make investigations on the air of mines. We have the results of these in this Appendix to the Report of the Commission, and we propose to devote a few pages to a *resumé* of them.

Before any conclusion could be arrived as to what was impure air, it was necessary to decide what normal air was. Fortunately a great number of—we might say all—the most eminent chemists have given us few or many analyses of air. It engaged the attention of all the earlier analysts, and, considering the disadvantages under which they worked, their results exhibit sufficient uniformity. Priestly, in his first experiments, found the difference of oxygen sometimes to amount to as much as 6 per cent.; Scheele's results with the same gas differed to the extent of 10 per cent.; others were even wider in their discrepancies. It was Cavendish who first arrived at anything like exact results, and showed from 500 examinations of air that it had a nearly constant composition, and that the mean percentage of oxygen was 20·833. Many thousands of analyses of air taken at the surface of the earth have been made by various methods since Cavendish died; but if all with any pretensions to accuracy were summed up, and the mean result calculated, it would only differ from Cavendish's number in a decimal place.

We have not space to quote more than the results of Regnault and Bunsen upon which Dr. Smith sets the greatest value. Regnault analysed the air of Paris and that from various parts of the world, and found an average of 20·949 per cent. of oxygen. Bunsen made a series of examinations of the air at Heidelberg, and there found a mean of 20·924 of oxygen. Dr. Smith adopts these results, and assumes what we may call normal air to contain 20·9 of oxygen.

Carbonic acid may be regarded as universally present in the atmosphere, and therefore it was necessary to decide what should be considered the normal proportion of this gas. Saussure occupied a good deal of his life in the examination of the atmosphere, and paid special attention to the determination of carbonic acid. His results exhibit variations of no great limits, the air round Geneva giving 0·035 to 0·054. But one unexpected result of his experiments was the discovery that the air on mountains contains more carbonic acid than that on the plains. The results of Brunner, Boussingault, Berger, and Frankland indicate a diminution of oxygen on the mountains,[*] and the increase of carbonic acid there is a corroboration.

Saussure accounts for the diminution of carbonic acid on the plains by the rain which washes the air, and vegetation, which consumes the acid. Dr. Frankland found 0·111 per cent. of carbonic acid in air taken at the Grand Mulets (there was less at the summit of Mont Blanc); and the Schlaginweits assert an increase of the gas up to a height of 11·000 feet.

Dr. Smith accounts for this increase of carbonic acid on the mountains on the supposition that organic matter is in the higher regions more completely oxidated, which, at the same time, accounts for the diminution of oxygen. We have then, he says, two distinct varieties of air: one on the mountains, in which there is more carbonic acid and less oxygen, but no organic matter; and another on the plains, in which we have less carbonic acid, more oxygen, and more or less organic matter. With the last of these we cannot at present occupy ourselves; but so far as carbonic acid is concerned we may note that Dr. Smith considers the normal proportion of this gas in a wholesome atmosphere to be 0·04 per cent. Normal air, then, we may assume to be composed of—

Oxygen	20·96
Carbonic acid	0·04
Nitrogen	79·00
	100·00

With these proportions before us we may proceed to the air of impure places.

(To be continued.)

Chemisches Central Blatt. Nos. 5, 6, 7, 1864.

We have in these papers, as usual, abstracts of the papers published in other journals, but no original articles. Most of these papers we have already noticed, but we find several short abstracts which we shall transfer to our pages.

NOTICES OF PATENTS.

1519. *Grinding and Polishing Glass.* J. H. Johnson, Lincoln's Inn Fields, London. A communication. Dated June 18, 1864.

In the grinding and polishing of convex and concave glass surfaces the inventor claims the adoption of the method commonly employed in the preparation of plane surfaces—viz., by rubbing the two surfaces together with emery, putty powder, or other grinding or polishing material placed between. In this way it is proposed to grind convex and concave surfaces simultaneously by mutual attrition, and it is only necessary that the curves should be suited to each other.

1520. *Manufacture of Looking-glasses, Mirrors, &c.* J. H. Johnson, Lincoln's Inn Fields, London. A communication. Dated June 18, 1864.

As a substitute for silver, or the amalgam of tin, commonly used as the reflecting surface in looking-glasses and mirrors, the inventor proposes to employ foil or polished surfaces of platinum.

There was an effort made many years ago to introduce incorrodible platinum reflectors, made by coating the inner or concave surfaces of china or earthenware plates with the reduced metal applied as an enamel.

1525. *Obtaining Colouring Matters.* R. Smith and C. Sieberg, Glasgow. Dated June 20, 1864.

For the production of violet dyes the inventors treat rosaniline, or a salt of that base, with hydriodic acid and alcohol, or methylated spirit. They prefer to use these ingredients in the following proportions—viz.: 75 parts of rosaniline, and 160 parts each of methylated alcohol and concentrated hydriodic acid of the boiling point 250° F. This last-named reagent they propose to make by the action of hydrosulphuric acid upon iodine suspended in water, and afterwards concentrate the product by driving off by heat the large excess of water. The operation of heating the mixture aforesaid is conducted at the temperature of 250°—270° Fahr. in a closed iron vessel lined with lead, and maintained for about four hours, or until the desired tint of colour is produced.

1529. *Improvements in the Means of Preventing the Formation of, and in the Removal of, Incrustations or Deposits from Steam-engine Boilers.* J. H. Beattie, Dowgate Hill, London. A communication. Dated June 20, 1864.

This boiler composition, or anti-incrustation powder, consists of chloride of ammonium in admixture with mahogany sawdust and raw sugar. For its preparation the patentee directs to take by weight

Hydrochloric acid . .	25 parts.
Liquor ammonia . .	25 „
Sugar	33 „
Mahogany dust . .	17 „

It will be perceived that the patentee prefers to mix together hydrochloric acid and ammonia for the purpose of obtaining sal-ammoniac, and so far as the employment of this agent is recommended the process resolves itself into a modification of that proposed many years ago by Ritterbandt. By the action of sal-ammoniac upon the carbonate of lime in the water, chloride of calcium is formed with elimination of carbonate of ammonia vapour with the steam.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

2704. W. Smith, Salisbury Street, Strand, "Improvements in tanning leather, and in the apparatus to be employed for that purpose." A communication from A. Jullien, Nantes, France.—Petition recorded Nov. 2, 1864.

2719. C. Garton, Bristol, and Thomas Hill, Southampton, "Improvements in brewing, fermenting, racking, and bottling beer, ale, and wine."—Nov. 3, 1864.

27. N. Thompson, Abbey Gardens, St. John's Wood, "Improvements in stoppers for bottles, jars, vessels, and tubes, also for ordnance and firearms."—Jan. 4, 1865.

249. V. Burg, Paris, "Improvements in filtering apparatuses."—Jan. 28, 1865.

344. W. Sim, Glasgow, N.B., "An improved method of, and improvements in apparatus for, extracting gases from mineral oils, and employing the same for illuminating purposes."—Feb. 7, 1865.

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[*] Dr. Miller found only 20·88 per cent. of oxygen in air taken in a balloon ascent at 18,000 feet.

398. P. A. le Comte de Fontaine Moreau, Paris, "Certain improvements in the manufacture of caoutchouc." A communication from L. D. Innocent and F. Perroucel, Montrouge, France.—Feb. 11, 1865.

443. E. B. Wilson, Glasgow, N.B., "Improvements in furnaces."—Feb. 16, 1865.

464. J. J. Chidley, Glaskin Street, Hackney, "An improved method of stopping bottles."

469. J. Graham, Manchester Road, Warrington, Lancashire, "Improvements in treating products obtained when coating iron with zinc."

473. J. G. N. Alleyne, Alfreton, Derbyshire, "Improvements in puddling furnaces, and in apparatus connected therewith."—Feb. 18, 1865.

481. R. Willison, Alloa, N.B., "Improvements in mashing machines, and in apparatus connected therewith."—Feb. 21, 1865.

Notices to Proceed.

2706. J. Forster, Rathgan, and H. Draper, Rathmines, Ireland, "Improvements in the preparation or manufacture of paper, in order to prevent the extraction or alteration of writings thereon without detection."—Petition recorded Nov. 2, 1864.

2723. F. L. Beauwens, Walworth, Surrey, "Improvements in cooking food."—Nov. 4, 1864.

456. J. O. Christian, F.C.S., Manchester, and J. and H. Charlton, Strangeways, Lancashire, "Certain improvements in the manufacture of magnesium and its compounds."—Feb. 17, 1865.

CORRESPONDENCE.

Continental Science.

Paris, March 14.

You said some time ago that an original idea might occur to two men at the same time. I think we have an illustration of this fact. M. Duchemin has just published an account of a modified Bunsen's battery, in which he uses the same liquid, a solution of perchloride of iron, that your correspondent, Mr. Reynolds, suggested some time ago in the Chemical News. M. Duchemin has gone a step further, and substituted a solution of chloride of sodium for sulphuric acid with the zinc, with the loss, of course, of some force, but still with enough to excite a small Rhumkorff with one cell; and by surrounding the zinc with water alone he gets a constant current, useful for telegraphic purposes.

M. Alexandre is a large maker of steel pens. He has establishments at Paris, at Brussels, and at Birmingham, and he has occupied himself a good many years, he says, in perfecting metallic pens. These having arrived at a state of perfection, M. Alexandre finds that there is something wrong with all the inks. They destroy the paper and spoil the pens, and so bring a perfect article into unmerited disrepute. Therefore M. Alexandre offers a prize of 1500 francs for a perfected ink. He has, indeed, a direct interest in the rapid destruction of steel pens, but he has a soul above pens, and rather than a perfected manufacture should be reproached with failures not its own, he offers this prize for an uncorroding ink, though the result may be that one steel pen will last a lifetime, and ink-makers may flourish while pen-makers decay. M. Alexandre is very disinterested, and I hope some ingenious chemist will be able to suit him with an ink. The Society for the Encouragement of Industry will award the prize six months after its official announcement, which has not yet been made.

A public laboratory was opened at Strasburg on the 1st of January, in which work is done upon much the same terms as under your Adulteration Act. The prefect of the department has fixed the tariff of charges, which are as under:—For a water analysis, 10 to 15 francs; for a quantitative analysis of manures and trade products, 6 francs. The work is done at the laboratory of the Upper School of Pharmacy, and I should think the charges would convince the students of the inadvisability of pursuing analytical chemistry as a means of getting a livelihood—at all events, in the Department of the Bas-Rhin.

Soot, it is found, does not cure pébrine, the name given to the disease which has threatened to exterminate silkworms in France, and M. Onesti will not, therefore, get the trifle of 500,000 francs which he modestly expected for his notable and original suggestion.

A recent traveller in Abyssinia, Mgr. Van den Deck, has sent to the Belgian Royal Society an interesting account of the tape-worm which so commonly afflicts the inhabitants of that country. I said afflicts; but the expression must be qualified, for it seems that the possession of worm is by some considered a means of increasing their enjoyments. They take small doses of kousso only to get rid of the body, when the worm gets of an inconvenient size; but they are anxious to retain the head, for they are terrible gluttons, and having a tenia enables them to eat so much more. Here is a hint for aldermen and gourmands in general. The tenia common in Abyssinia is *T. mediocancellata.*

There is probably no reader of the Chemical News who is not familiar with the test for the detection of chicory in coffee just published by M. Coulier; and I only quote it for the sake of the explanation he gives. Coffee, we all know, swims on water, while chicory sinks. The reason for this, says M. Coulier, is, that in the roasting of coffee the berry becomes distended, so to say, with carbonic acid, while in the roasting of chicory no gas is disengaged.

M. Thibierge, of Versailles, suggests a method of exhibiting diagrams of apparatus, &c., which may at all events save lecturers the expense of the large pictures now commonly in use. He makes a small sketch of the apparatus on a plate of glass, and with a large lantern throws a magnified image on a screen. The lantern he illuminates by an ordinary gas burner with twenty-four holes, and with two silvered reflectors finds the light sufficient even to give a well-defined image of the electrolysis of water.

Destruction of Parasites.

To the Editor of the Chemical News.

Sir,—As I have been a severe loser in consequence of a communication to your journal of January 20, I trust you will do me the favour of inserting the following case:

A large and valuable retriever, aged four years, with traces of mange about him, was treated as recommended by Mr. Israel Swindells, of Wigan; with the exception that the solution was half the strength mentioned by that gentleman. This was on Tuesday, middle day, and on my visiting him eight hours subsequently I found him dejected in spirits and unwilling to eat. Severe purging and vomiting set in, and continued until Thursday, the excretions being markedly of a green and unnatural colour. He was immediately washed, the abdomen and neighbourhood of the larger joints being found to be quite raw. Stimulants and warmth were freely applied, but the animal gradually sank, and died early Monday, never seemingly having attempted to rally. After death the lips and inside of the mouth were found to be extensively ulcerated. Apologising for encroaching on your valuable space. I am, &c. One who loved his Dog.

South Kensington, March 8.

MISCELLANEOUS.

Royal Institution.—The following are the arrangements for the ensuing week:—Tuesday, March 21, at 3 o'clock, Professor Masson, "On Recent British Philosophy." Thursday, March 23, at 3 o'clock, Professor Masson, "On Recent British Philosophy." Friday, March 24, at 8 o'clock, Professor Westmacott, "How Works of Art should be Looked at." Saturday, March 25, at 3 o'clock, Professor Marshall, "On the Nervous System."

The Royal Society's Soirce.—On Saturday evening last the President gave his first *soirée* during the present year, at Burlington House, which was honoured by the presence of His Royal Highness the Prince of Wales and a distinguished circle of visitors. The rooms of the Royal and Linnean Societies were those set apart for the reception, and a variety of interesting objects were exhibited, particularly we noticed the following:—A series of original drawings by Albert Dürer, Claude Lorraine, and other old masters, from the Queen's collection. Paintings illustrative of Explorations in South-West Africa, by Mr. Baines, and model of the Victoria Falls, Zambesi River. Messrs. Marion and Co.'s photographs of Turner's pictures. Ancient marble statuette of Venus, from Crete. A magnificent series of Chinese enamels on copper and Japanese nature-castings in bronze were exhibited by Mr. Alfred Tylor. A large model of a 3000 ton, 800 horse power, steam yacht, now building for the Pacha of Egypt by Mr. Samuda, which it is expected will be the fastest vessel afloat. A very complete collection of Stone Implements recently found in Poitou, by Messrs. Evans and Christy, and another series of flint, bone, and horn implements from the Dordogne Caves, were exhibited by Messrs. Christy and Lartet; also, Mr. Brady's ancient flint and bronze implements from Denmark. A variety of natural history specimens and products from West Africa, Japan, &c., were shown by Dr. Welwitsch, Mr. S. W. Silver, and others. Among the electrical apparatus were Thomson's Electrometer, arranged for photographic registration, by Messrs. Elliott, Brothers; a large Electro-Chronograph, about to be used for the determination of longitude in the great trigonometrical survey of India, exhibited by Lieut.-Col. A. Strange, F.R.S.; Mr. Fleming Jenkin's new Unit of resistance; Gisborne's Ship Signals, by Silver and Co.; a working model of Froment's Electro-magnetic Engine, by Prof. Tyndall, who also showed his apparatus for experiments on invisible radiation. Microscopes were exhibited by Messrs. Smith and Beck, Powell and Lealand, Mr. Ladd, and Mr. J. Browning. The last-named gentleman showed a large prism in flint glass, measuring five inches by four, and a very beautifully executed hollow glass sphere, which is intended to be used in some experiments on the density of gases. The Herschel-Browning direct vision Spectroscope was likewise shown. The $\frac{1}{50}$th inch object-glass of Messrs. Powell and Lealand excited much attention. A pair of horns of *Bos antiquus*, discovered at Camberwell whilst digging for the main drainage, and a model of the Thames Embankment, were exhibited by the Metropolitan Board of Works. Besides the above, some fine specimens of wood carving, by Mr. W. H. Rogers; of electro-sculpture, by Mr. Durham; and the Wedgwood medallions of Dr. Sibson, and electrotypes of antique gems of Mr. J. Williams, were much admired.

Spontaneous Disengagement of Free Iodine in a Mineral Water.—On uncorking a bottle half full of the Heilbronn mineral water from the Adelheid spring, after it had been for several years in the bottle, a strong odour of iodine arose from it; the water turned starched paper blue, and consequently contained free iodine. The experiment was repeated with two other bottles of this water; with one it succeeded, with the other the paper was made blue only by immersion in the air of the bottle.—*Wittstein, Chem. Centralbl.*, p. 1069. 64.

Test for Tartar Emetic.—Claus points out that perchloride of iron causes a yellow colouration in a strong solution of tartar emetic; but in a dilute solution occasions a yellow precipitate, which seems to consist of a mixture of basic chlorides of antimony and iron and some tartar emetic.—*Chem. Central Blatt.*

Obituary.—We regret having occasion to announce the death of R. L. Chance, Esq., late of Summerfield House, near Birmingham, which occurred on the 7th inst., whilst visiting friends at Gravesend. Mr. Chance devoted himself during a long life to the improvement of glass, and has in this way done much to aid the researches of astronomers, microscopists, and physicists. The English opticians and artists in many branches are mainly indebted to him for the manufacture and supply of superior qualities both of white and coloured glass. He died in his eighty-third year, and his removal will cast a gloom over the forthcoming meeting of the British Association.

Colouring Matter of Ripe Olives.—Landerer finds that the colouring matter of ripe olives can be extracted by simply boiling with water, which gives a purple decoction, made red by acids and green by alkalies. The decoction dyes cotton and wool shades from a beautiful violet to crimson, and the author believes that the colour may be found useful for technical purposes.—*Chem. Central Blatt.*

The Preparation of Hypochlorite of Soda.—By substituting a solution of bicarbonate of soda for one of carbonate in the preparation of hypochlorite of soda, a precipitate of carbonate of lime is obtained in the form of a crystalline powder, depositing itself very easily, whilst, when a solution of ordinary carbonate of soda is employed, a kind of magma forms, which it is difficult to separate from the liquid by decantation. A small excess of bicarbonate of soda in the liquid is, as has been proved by experiment, very advantageous in some respects. With hypochlorite of soda thus prepared hardly a minute is required to bleach any kind of engraving or printing without in the least degree damaging the paper, especially if it be immediately afterwards plunged for a few seconds in water in which a little acid sulphate of soda has been dissolved.—*Journal de Pharmacie et de Chimie*, I. 143. 65.

Rapid Absorption of Crystalloid Substances.—Dr. Bence Jones has communicated instances of the extraordinarily rapid passage of some substances into the vascular and non-vascular tissues of the body. Lithium administered to a guinea pig eight hours before death was found in the crystalline lens. In another pig killed two hours and a-half after the administration, the presence of lithium in the cartilage of the hip was distinctly shown. In another animal, killed after an hour, it was shown faintly in the hip and knee, but in the aqueous humour of the eye very distinctly. It was also found in the crystalline lens and joint cartilages of human subjects who took lithia within a very few hours of death.

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. *Private* letters for the Editor must be so marked.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. X. of the Chemical News, containing a copious Index, is now ready, price 11s. 0d., by post, 11s. 6d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. XI. commenced on January 6, 1865, and will be complete in 26 numbers.

Cavendish.—We were not at the meeting, but we have applied to the Secretary for a copy of the Report, which has not yet been forwarded.

θ.—Either Heidelberg or Berlin. Write to the Professors for information.

Received.—E. Divers, M.B.; shall be published next week. Jno. Horsley, Esq., next week; A Subscriber; Al-Chemicus.

THE BILLS FOR REGULATING THE QUALIFICATIONS OF CHEMISTS AND DRUGGISTS.

THE rival Bills for regulating the qualifications of chemists and druggists are now before the House of Commons, and will probably be consigned to the ordeal of a Select Committee, before which the two societies must fight out their claims to be considered the exclusive representatives of their order. Which Bill, under these circumstances, is likely to become the law of the land it is impossible to conjecture. Probably neither will be passed this Session, or an enactment compounded of both may be successful, which, perhaps, is the best thing that could happen. Taken apart, each Bill contains salutary provisions, but, as a whole, neither can be regarded as entirely satisfactory. That of the United Society seems to provide cumbrous machinery for effecting simple objects, but in most other respects is reasonable. As, however, we have not yet the entire Bill before us, it is somewhat premature to express an opinion. The Bill of the Pharmaceutical Society cannot be regarded with so much satisfaction. One serious omission has been made at starting. Clause 1 would leave the retail trade in medicines and poisons completely without control, for it defines the business of a chemist as the "keeping of open shop for the compounding of the prescriptions of duly qualified medical men." Now, one would think that the Council of the Society must be aware that there are hundreds of chemists and druggists in the country who never dispense a prescription, or, at all events, who dispense so few as to make that department of their business of no consideration. A subsequent clause of the Bill, it is true, places restrictions on the use of the title "chemist and druggist;" but any man who wishes to open a shop and retail medicines has only to put show bottles in his window, and it is unnecessary for him to use any title at all if he found a difficulty in inventing an equivalent for the term chemist and druggist. The objections to this part of the Bill have been so well urged by one of the most intelligent supporters of the Society that it is unnecessary for us to dwell upon them further.

Another feature of the Bill which is certain to cause much opposition is the proposal to create two orders of pharmaceutists. There is not the smallest necessity for this, and the proposal may be taken as an indication of great weakness or great selfishness on the part of the projectors of the measure. It is useless to argue the unfairness of men who have taken no interest in the Society being at once admitted to an equality with those who have devoted themselves to its interest for years. It must be so; and it is ever so in life, that men who have borne the burden and heat of the day find themselves at last with no greater reward than those who joined in a work at the eleventh hour. The Council had better, therefore, submit to it with the best grace they can, and consent to an amendment, at the risk of considerable changes in their own body. The reproach of being governed by a clique, which is continually brought against the Society, cannot, if deserved, be too quickly got rid of.

There is another point dwelt on by Sir John Shelley which is certain to command some support for the Bill of the United Society, and that is the proposal to regulate the sale and custody of poisons. We have urged before the absence of necessity for such regulations, and we still hold the same views on the question. But unfortunately, the public is not with us, and general opinion demands a Poison Bill. It would better, then, to concede the matter; for if any inconveniences follow it will be the public who will suffer, and not the trade.

With such alterations and additions, we see no reason why a bill emanating from the Pharmaceutical Society should not become law, and the Society retain its place at the head of the trade. It deserves consideration for past services, and if at times we have occasion to denounce its pretensions as too high, and its aims as too exclusive, it is probably because the general body take but little interest in its management. For this reason we look to a large accession of members as likely to conduce to the interests of the Society itself, but we rest our objection to the two orders upon wider grounds. Each of the Societies includes some of the most intelligent and some of the most ignorant men in the trade. Why should not the Pharmaceutical Society be ready to avail itself of all the intelligence? and why should one fool enjoy privileges denied to another?

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

An Introduction to Chemical Philosophy, according to the Modern Theories, by ADOLPHE WURTZ, *F.R.S.*

PART I.

EQUIVALENTS, ATOMIC WEIGHTS AND MOLECULAR WEIGHTS.

SECTION II.—*New System of Atomic Weights.*

(*Continued from page* 122.)

GERHARDT's system of atomic weights and notation never received the unanimous assent of chemists; and the discoveries made of late years seem to show that their author went too far in the reform which he inaugurated. It has been previously shown that he compared the protoxides to water, and had attributed to them the general formula R_2O, and that the equivalents of the metals were, in consequence, doubled. The density of mercury vapours *seemed* to furnish an argument in favour of such a reduction, but this argument is really of little value. The density of mercury vapour is evidently an anomaly, which we will endeavour to define and explain further on. The vapour-densities of chloride, bromide, and iodide of mercury assign to this element an atomic weight double that which is deduced from the anomalous density of its own vapour.

Moreover, the reduction of the atomic weights of most of the metals as proposed by Gerhardt would be contrary to the law of Dulong and Petit, to which the accurate researches of M. Regnault have latterly drawn attention.

M. Regnault remarked that as early as 1849* the law of Dulong and Petit applied to all the elements with a few exceptions; and that to bring these under the influence of the same general law it was only necessary to double the equivalents of hydrogen, nitrogen, chlorine, bromine, iodine, phosphorus, arsenic, potassium, sodium, and silver; "for," said he, "the equivalents of these bodies, as given by their specific heats, are half those which have been fixed upon from chemical considerations." He justly said that the numbers so obtained no longer represented equivalents, and he proposed to term them *Thermic proportional numbers.*

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* *Annales de Chimie et de Physique*, 3rd series, xxvi., 261. See also *Premiers Elements de Chemie*, by M. Regnault. 1850, p. 544.

To double the equivalents of hydrogen, nitrogen, chlorine, bromine, iodine, phosphorus, and arsenic was to return in the case of these metalloids to the atomic weights of Berzelius.

Gerhardt had already done this, but while the latter chemist required for all metals atomic weights half as great as their equivalents, Regnault confined this reduction to the equivalents of potassium, sodium, and silver, to which he has lately added lithium. Gerhardt supposed that all the protoxides, R_2O, possessed the atomic composition of water, H_2O. In adopting the numbers proposed by M. Regnault, this supposition is confined to the oxides of the alkali metals and to oxide of silver, the formulæ of which become—

	Of potassium.	Of sodium.	Of lithium.	Of silver.	
Oxides .	K_2O	Na_2O	Li_2O	Ag_2O	analogous
Hydrates .	$(KH)O$	$(NaH)O$	$(LiH)O$		to H_2O.

The other oxides in which one atom of oxygen is united with one instead of two atoms of metal have their composition expressed by the general formula RO. Each atom of one of these latter metals corresponds, therefore, to two atoms of potassium or two atoms of hydrogen; this is at present expressed by saying that they are diatomic. The following oxides are of this class:—

$$Ba''O, Sr''O, Ca''O, Mg''O, Mn''O, Fe''O, Zn''O, Pb''O, Hg''O.$$†

The idea of diatomic metals was first announced by M. Cannizzaro‡; the principal argument in favour of this idea was founded on the existence of diatomic radicals§ in organic chemistry—an idea which was introduced into science by my own experiments on the formation of glycol with diniodide or dibromide of ethylene. These experiments showed that ethylene or propylene, which combine with two atoms of bromine or chlorine, can also replace two atoms of silver or hydrogen, and are consequently equivalent to two atoms of a monatomic element.‖

But organic radicals are the representatives of the elements in the mineral kingdom, and the existence of polyatomic organic radicals constitutes a powerful argument in favour of the polyatomicity of certain metals. It must be mentioned that this idea of the polyatomicity of certain elements dawned upon chemistry slowly and by degrees. This is too important a point to be passed over slightly; we will return to it again, merely mentioning at present that Dr. Odling first suggested that those metals should be considered as triatomic which are in combination with three atoms of oxygen in the sesquioxides R_2O_3.

It has been already mentioned that the atomic weights deduced from the law of Dulong and Petit, and which represent the thermal equivalents of simple bodies, are the same as the atomic weights of Berzelius, except in the case of the alkali metals and silver. This will be seen by the following table, in which the new atomic weights are compared with those of Berzelius and of Gerhardt. To assist comparison, all these atomic weights have been reduced to the same standard (hydrogen = 1). The numbers in the third column have been obtained by dividing by 6·24—that is to say, by the atomic weight of hydrogen on the O = 100 scale,—the atomic weights of Berzelius as given in the table on page 99.

Names of the Elements.	New Atomic Weights.	Atomic Weights of Berzelius.	Atomic Weights of Gerhardt.
Hydrogen .	1	1	1
Oxygen . .	16	16	16
Nitrogen .	14	14·02	14
Chlorine .	35·5	35·52	35·5
Bromine .	80	80·09	80
Iodine . .	127	127·08	127
Fluorine .	19	18·70	19
Sulphur. .	32	32·17	32
Selenium .	79·5	79·37	79·5
Tellurium .	129	128·48	129
Phosphorus .	31	31·41	31
Arsenic . .	75	75·22	75
Carbon . .	12	12·04	12
Boron¶ . .	11	21·82, of which $\frac{1}{2}$=10·91	11
Silicium . .	28	44·51, of which $\frac{2}{3}$=29·66	,,
Zirconium** .	89·6	67·26, of which $\frac{4}{3}$=89·6	,,
Potassium .	39·1	78·47	49
Sodium . .	23	46·43	23
Lithium. .	7	13·08	7
Silver . .	108	216·29	108
Barium . .	137	137·06	68·5
Strontium .	87·5	87·48	43·75
Calcium. .	40	40·32	20
Magnesium .	24	25·34	12
Aluminium .	27	27·39	13·75
Manganese .	55	55·23	27·5
Chromium .	53·5	52·70	26·25
Uranium .	120	118·88	60
Iron . .	56	56·17	28
Cobalt . .	59	59·07	29·5
Nickel . .	59	59·19	29·5
Zinc . .	65·2	65·16	32·6
Cadmium .	112	111·66	56
Copper . .	63·5	63·39	31·75
Lead . .	207	207·47	103·5
Bismuth .	210	213·20	210
Tin . .	118	117·83	59
Titanium .	50	48·3	25
Tungsten .	184	190·44	92
Molybdenum.	96	95·53	48
Vanadium††.	68·6	137·32	,,
Antimony .	122	129·24	122
Mercury .	200	200·52	100
Rhodium .	104·4	104·48	,,
Palladium .	106·6	106·64	,,
Platinum .	197·5	197·44	98·5
Iridium . .	198	197·44	98·5
Ruthenium .	104·4	,,	,,
Osmium .	199·2	199·13	,,
Gold . .	197‡‡	196·98	,,

It will be seen that with few exceptions the new system of atomic weights is almost identical with that of Berzelius; and that in respect to the metals, the

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[†] The accents ′ ″ ‴, the employment of which in chemistry was introduced by Dr. Odling, show atomicity or substitution value: Ba″, is equivalent to 2H′ in respect to O″ in the combinations $\left.\begin{matrix}H'\\H'\end{matrix}\right\}O''$ and Ba″ O″.—(*Quarterly Journal of the Chemical Society*, 1856, vii., 1.)

[‡] *Sunto di un corso di filosofia chimica fatto nella R. Università di Genova*, dal Prof. S. Cannizzaro. Pisa. 1858, p. 35.

[§] *Ibid*, page 34.

[‖] *Leçons professées à la Société Chimique de Paris*, I, 108.

[¶] Berzelius wrote boric acid BoO_3, and chloride of boron $BoCl_3$, or $BoCl_6$, whilst he represented the composition of silicic acid and chloride of silicium by the formulæ SiO_3 and $SiCl_6$. According to the vapour densities of chlorides of boron and silicium, it is better to represent their composition by the formulæ $BoCl_3$ and $SiCl_4$, and consequently that of boric and silicic acids by the formulæ Bo_2O_3 and SiO_2. The atomic weight which Berzelius attributed to boron must, therefore, be reduced one-half, and that of silicium two-thirds.

[**] Berzelius represented zirconia by the formula Zr_2O_3. By adopting the formula ZrO_2, the atomic weight of zirconium is increased by $\frac{1}{3}$.

[††] Berzelius wrote perchloride of vanadium VCl_6.

[‡‡] A description and discussion of the analytical methods by which these numbers have been obtained would be beyond the domain of this work. The reader may consult with advantage on this subject the numerous memoirs of M. Dumas and the classical researches which have been lately published by M. Stas (vide Chemical News, vol. iv., pp. 181, 206, 215, 228, 243, 257, 270, 282, 297, 307, 324, 335, and vol. v., pp. 1, 15, 29, 57).

new atomic weights are double those which Gerhardt adopted, except those of the alkali metals, and silver, bismuth, and antimony.

It now remains to demonstrate that this system of atomic weights is in better harmony than any other; first, with the physical data which serve for the control and determination of atomic weights, and second, with the chemical facts.

The physical data made use of are:

1. The law of specific heats.
2. Isomorphism.
3. Vapour densities.

(To be continued.)

*On the Theory of Types in Chemistry,**
by T. Sterry Hunt, *M.A., F.R.S.*

(Continued from page 125.)

Keeping this principle in mind, let us now examine the theory of the formation of acids. As we have just seen, I taught in 1848 that the monobasic, bibasic, and tribasic acids are derived respectively from one, two, and three molecules of water, H_2O_2. Mr. Wurtz seven years later (in 1855) put forth a similar view. He supposes a monatomic radical PO'_4, a diatomic radical $P''O_3$, and a triatomic radical PO'''_2, replacing respectively one, two, and three atoms of hydrogen in H_2O_2, H_4O_4, and H_6O_6, thus $(PO'_4H)O_2$, $(PO''_3H_2)O_4$ and $(PO'''_2H_3)O_6$. These radicals evidently correspond to PO_5, which has lost one, two, and three atoms of oxygen in reacting upon the hydrogen of the water type, and these acids may be accordingly represented as formed by the substitution of the residue $PO_5—O$ for H, &c.

To this manner of representing the generation of polybasic acids we object that it encumbers the science with numerous hypothetical radicals, and that it moreover fails to show the actual successive generation of the series of acids in question. When phosphoric anhydrid, $P_2O_{10} = (PO_4)_2O_2$, is placed in contact with water it combines with one equivalent, H_2O_2. The union is followed by homogeneous differentiation, and two equivalents of metaphosphoric result,

$$(PO_4)_2O_2 + H_2O_2 = 2(PO_4H)O_2.$$

Two equivalents of this acid with one of water at ordinary temperatures are slowly transformed into two of pyrophosphoric acid by a reaction precisely similar to the last.

$$2(PHO_6) = (PHO_5)_2O_2 + H_2O_2 = 2(PHO_5H)O_2,$$

and two equivalents of pyrophosphoric acid when heated with a third equivalent of water yield, in like manner, two of tribasic phosphoric acid,

$$2(PH_2O_7) \quad (PH_2O_6)_2O_2 + H_2O_2 = 2(PH_2O_6H)_2O_2 = 2PH_3O_8.$$

Gerhardt long since maintained that we cannot distinguish between polybasic salts and what are called sub-salts, which are as truly neutral salts of a particular type. Thus the bibasic and tribasic phosphates are to be looked upon as sub-salts, which sustain the same relation to the monobasic phosphates that the basic nitrates bear to the neutral nitrates. He succeeded in preparing two crystalline subnitrates of lead and copper, having the formulas NO_5,M_2O_2,HO (tribasic), and NO_5,M_4O_4,H_2O_2 (quadri or heptabasic), both of which retain their water of composition at 392° F. The compounds of sulphuric acid are:—1st. The true monobasic sulphate S_2O_6MO, corresponding to the Nordhausen acid and the anhydrous bisulphates; 2nd. The ordinary neutral sulphates, S_2O_6,M_2O_2; 3rd. The so-called disulphates, S_2O_6,M_4O_4, corresponding to the glacial acid density 1·780; 4th. The type S_2O_6,M_6O_6, represented by turpeth mineral; and 5th. The so-called quadribasic sulphates, S_2O_6,M_8O_8. The copper salt of this type, according to Gerhardt, retains, moreover, 6HO at 392° F. —(Gerhardt on Salts, *Jour. de Pharmacie*, 1848, vol. xii.; *Am. Jour. Sci.*, vi. 337.)

Without counting the still more basic sulphates of zinc and copper described by Kane and Schindler, we have the following salts, which, in accordance with Wurtz's notation, correspond to the annexed radicals:—

1. Monobasic . .	S_2HO_7	$= S_2O_5$	monatomic.
2. Bibasic . .	$S_2H_2O_8$	$= S_2O_4$	diatomic.
3. Quadribasic .	$S_2H_4O_{10}$	$= S_2O_2$	tetratomic.
4. Sexbasic . .	$S_2H_6O_{12}$	$= S_2$	hexatomic.
5. Octobasic . .	$S_2H_8O_{14}$	$= S_2 - O_2$	octatomic.

It is easy to apply a similar *reductio ad absurdum* to the radical theory in the case of the oxychlorides and other basic salts, and to show that the radicals of the dualists are often merely algebraic expressions.—(See further my remarks in the *Am. Jour. Science*, vii. 402—404.)†

The above, which we conceive to be a simple statement of the process as it takes place in nature, dispenses alike with hypothetical radicals and residues, both of which are, however, convenient for the purposes of notation. In the selection of a typical form, to which a great number of species may be referred, hydrogen or water merits the preference from its simplicity and from the important part which it plays in the generation of species. Water and carbonic anhydrid are both so directly concerned in the generation of the bodies in the carbon series that either may be assumed as the type, but we prefer to regard C_2O_4, like the other anhydrids, as only a derivative of the type of water, and eventually of the hydrogen type.

These views were first put forward by myself in 1848, when I expressed the opinion that they were destined to form "the basis of a true natural system of chemical classification;" and it was only after having opposed them for four years to those of Gerhardt, that this chemist, in June, 1852, renounced his views, and, without any acknowledgment, adopted my own.—(*Ann. de Chim. et Phys.* (3) xxxvii. 285.) Already, in 1851, Williamson, in a paper read before the British Association, had developed the ideas on the water type to which Wurtz refers above, and to him the English editor of "Gmelin's Handbook" ascribes the theory. The notion of condensed types, and of H_2 as the primal type, was not, so far as I am aware, brought forward by either of these, and remained unnoticed until resuscitated by Wurtz in 1855, seven years after I had first announced it, and one year of my reclamation, published in the *American Journal of Science* in March, 1854.

My claims have not, however, been overlooked by Dr. Wolcott Gibbs. In an essay on the polyacid bases he remarks, that in a previous paper he had attributed the theory of water types to Gerhardt and Williamson, and adds, "In this I find I have not done justice to Mr. T. Sterry Hunt, to whom is exclusively due the credit

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* We willingly reprint this article at the request of the learned author, who is reasonably anxious that his own share in the development of the ideas now generally received should not be overlooked. —Ed. C.N.

† Those who are familiar with chemical literature will remember an amusing *jeu d'esprit* of Laurent's, in which he invited the attention of the advocates of the radical theory to a newly-invented electro-negative radical *Eurhizene.*—*Comptes Rendus des Travaux de Chimie* for 1850, pp. 251 and 376. We observe a late writer in the Chemical News (vol. i., p. 326) proposing as a new electro-negative radical, under the name of hydrine, the peroxide of hydrogen, HO_2, the curhizene of Laurent.

of having first applied the theory to the so-called oxygen acids and to the anhydrids, and in whose earlier papers may be found the germs of most of the ideas on classification usually attributed to Gerhardt and his disciples." (*Proc. Am. Assoc.*, Baltimore, May, 1858, p. 197.) It will be seen from what precedes that I not only applied the theory, as Dr. Gibbs remarks, but, except so far as Laurent's suggestion goes, invented it and published it in all its details some years before it was accepted by a single chemist.

In conclusion, I have only to ask that future historians will do justice to the memory of Auguste Laurent, and will ascribe to whom it is due the credit of having given to the science a theory which has exercised such an important influence in modern chemical speculation and research, remembering that my own publications on the subject, which cover the whole ground, were some years earlier than those of Williamson, Gerhardt, Wurtz, or Kolbe.

*Experiments on the Action of the Air on Vegetable Fatty Oils,** *by M.* S. Cloez.

It may be asked under what form the carbon and hydrogen are eliminated in the course of the oxidation of oils. I agree with Saussure, that a portion of the carbon passes to the state of carbonic acid, but I have, moreover, ascertained that the amount of carbonic acid produced does not nearly represent the whole of the carbon which has disappeared.

In the same way with hydrogen, part is disengaged as water, but it is also eliminated under some other form.

These facts are easily explained by the production of a carbonised volatile compound, the pungent odour of which greatly resembles that of acroleine; this is a substance which browns the sheets of unsized paper, serving to recover the oils exposed to the air.

Some old books are coloured in the same way, and I believe that this coloration is the result of the slow oxidation of the oil used in the printing ink, and the formation of a product possessing a stifling odour, similar to that which I have recognised in air which has been for about ten days in contact with a siccative oil.

Process for Finding Traces of Chromium in Irons, Cast Irons, Steels, and Ores,† *by M.* A. Terreil.

The following is a simple method by which, in exceptional cases, the presence of traces of chromium may be recognised:—

Treat the metal or ore by the ordinary processes, to separate the silica and obtain a liquid containing all the metals in solution, and in which the iron is at its maximum of oxidation; then precipitate the liquid by an excess of a very much concentrated solution of potash; then pour, drop by drop, into the solution containing the precipitate, and heated to 80° or 90°, a much diluted solution of permanganate of potash until the permanganate loses its colour; the reaction is terminated when the liquid takes a greenish tinge, owing to manganate of potash, which does not give oxygen.

Then filter, saturate the filtered liquid with acetic acid, which immediately reduces the small quantity of manganate of potash, that gave to the solution its green colour; then into the liquid, which has frequently a yellow tinge, pour acetate of lead, which determines a yellow precipitate of chromate of lead.

This process is equally applicable to discovering traces of tungsten, vanadium, and molybdene contained in irons, cast irons, steels, and iron ores.

TECHNICAL CHEMISTRY.

Valuation of Essence of Mustard.‡

Perfectly pure essence of mustard dissolves in concentrated sulphuric acid, with hardly any colouration; but the oils often fraudulently adulterated all become coloured, either red or brown, in presence of this acid.

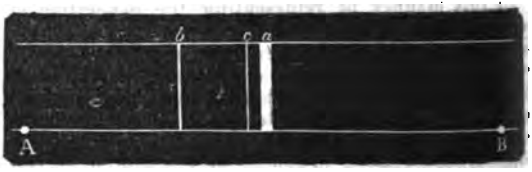
To test the essence introduce five drops of it, with fifty drops of concentrated and colourless sulphuric acid, into a small tube, and then shake them together. The colouration will soon become apparent if the essence be adulterated.

Rectified petroleum forms the exception, as sulphuric acid does not colour it, but its presence is betrayed by its insolubility in this acid. This may be proved by operating on twenty drops of essential oil; the essence of mustard dissolves, while the petroleum floats in the form of a limpid oil.

PHYSICAL SCIENCE.

The Spectrum of the Great Nebula in Orion.§

The result of my observation is truly astonishing. The light of the nebula is almost monochromatic and green, its spectrum is simply three luminous rays, of which the position is nearly as follows:—



The first ray (*a*) is tolerably wide and perfectly sharp; the second (*b*) is narrower, and is not far from it; these two rays are visible even when regarded through the spectroscope with the naked eye. Upon adding the eye-piece a third ray (*c*) is seen, very fine and close to *a*. The ray *b* appears violet, but the colours are deceptive. Upon introducing into the spectroscope the light from a mixture of sodium and strontium it is seen that the group of the nebula occupies the middle place between the yellow ray of sodium and the blue ray of strontium; the light, therefore, should be green; and, indeed, upon introducing the light of a spirit lamp, the wick of which has been soaked in boric acid, it is seen that the group of the nebula nearly corresponds to the second green band of boron. For the present that will suffice, but I hope soon to fix the places of the rays in a better manner. This spectrum offers a striking contrast to those of the small stars; as soon as one of these enters the slit of the instrument a wide coloured band is seen to flash across the field of vision; this is the continuous spectrum of the star, which does not differ from that of other stars except in faintness.

This discovery is very interesting in relation to the constitution of nebulæ; it shows that the mass of matter in this immense nebula is in a different state to the stars

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* Abstract from *Bulletin de la Société Chimique.*

† *Bulletin de la Société Chimique.*

‡ *Chem. Centralbl.*, p. 1071. 64.

§ Extract from a letter from Father Secchi to M. Faye, read before the French Academy, March 6, 1865.

themselves, as Mr. Huggins has already remarked of the planetary nebulæ.[‖]

On the Spectrum of the Great Nebula in the Sword Handle of Orion,[*] *by* WILLIAM HUGGINS, *F.R.A.S.*

In a paper recently presented to the Royal Society[†], I gave the results of the application of prismatic analysis to some of the objects in the heavens known as nebulæ. Eight of the nebulæ examined gave a spectrum indicating gaseity, and, of these, six belong to the class of small and comparatively bright objects which it is convenient to distinguish still by the name of planetary. These nebulæ present little indication of probable resolvability into discrete points, even with the greatest optical power which has yet been brought to bear upon them.

The other two nebulæ which gave a spectrum indicative of matter in the gaseous form, are 57 M, the annular nebula in Lyra, and 27 M, the Dumb-bell nebula. The results of the examination of these nebulæ with telescopes of great power must probably be regarded as in favour of their consisting of clustering stars. It was therefore of importance to determine, by the observation of other objects, whether any nebulæ which have been certainly resolved into stars give a spectrum which shows the source of light to be glowing gas. With this purpose in view I submitted the light of the following easily resolved clusters to spectrum analysis:—

"4670. 2120 h. 15 M. Very bright cluster; well resolved."[‡]

"4678. 2125 h. 2 M. Bright cluster, well resolved."

Both these clusters gave a continuous spectrum.

I then examined the Great Nebula in the Sword-handle of Orion. The results of telescopic observation on this nebula[§] seem to show that it is suitable for observation as a crucial test of the correctness of the usually received opinion that the resolution of a nebula into bright stellar points is a certain and trustworthy indication that the nebula consists of discrete stars after the order of those which are bright to us. Would the brighter portions of the nebula adjacent to the trapezium, which have been resolved into stars, present the same spectrum as the fainter and outlying portions? In the brighter parts, would the existence of closely aggregated stars be revealed to us by a continuous spectrum, in addition to that of the true gaseous matter?

The telescope and spectrum apparatus employed were those of which a description was given in my paper already referred to.

The light from the brightest parts of the nebula near the trapezium was resolved by the prisms into three bright lines, in all respects similar to those of the gaseous nebulæ, and which are described in my former paper.

These three lines, indicative of gaseity, appeared (when the slit of the apparatus was made narrow) very sharply defined and free from nebulosity; the intervals between the lines were quite dark.

When either of the four bright stars, α, β, γ, δ Trapezii was brought upon the slit, a continuous spectrum of considerable brightness, and nearly linear (the cylindrical lens of the apparatus having been removed), was seen, together with the bright lines of the nebula, which were of considerable length, corresponding to the opening of the slit. The fifth star γ′ and the sixth ɛ are seen in the telescope, but the spectra of these are too faint for observation.

The positions in the spectra of α, β, γ, δ Trapezii, which correspond to the positions in the spectrum of the three bright lines of the nebula, were carefully examined, but in no one of them were dark lines of absorption detected.

The part of the continuous spectra of the stars α, β, γ, near the position in the spectrum of the brightest of the bright lines of the nebula, appeared on a simultaneous comparison to be more brilliant than the line of the nebula, but in the case of γ the difference in brightness was not great. The corresponding part of δ was perhaps fainter. In consequence of this small difference of brilliancy, the bright lines of the adjacent nebula appeared to cross the continuous spectra of γ and δ Trapezii.

Other portions of the nebula were then brought successively upon the slit; but throughout the whole of those portions of the nebula which are sufficiently bright for this method of observation the spectrum remained unchanged, and consisted of the three bright lines only. The whole of this Great Nebula, as far it lies within the power of my instrument, emits light which is identical in its characters; the light from one part differs from the light of another in intensity alone.

The clustering stars of which, according to Lord Rosse and Professor Bond, the brighter portions of this nebula consist, cannot be supposed to be invisible in the spectrum apparatus because of their faintness, an opinion which is probably correct of the minute and widely separated stars seen in the Dumb-bell nebula, and to which reference was made in my former paper. The evidence afforded by the largest telescopes appears to be that the brighter parts of the nebula in Orion consist of a "mass of stars;" the whole, or the greater part of the light from this part of the nebula, must therefore be regarded as the united radiation of these numerous stellar points. Now, it is this light which, when analysed by the prism, reveals to us its gaseous source, and the bright lines indicative of gaseity are free from any trace of a continuous spectrum, such as that exhibited by all the brighter stars which we have examined.

The conclusion is obvious, that the detection in a nebula of minute closely associated points of light, which has hitherto been considered as a certain indication of a stellar constitution, can no longer be accepted as a trustworthy proof that the object consists of true stars. These luminous points, in some nebulæ at least, must be regarded as themselves gaseous bodies, denser portions, probably, of the great nebulous mass, since they exhibit a constitution which is identical with the fainter and outlying parts which have not been resolved. These nebulæ are shown by the prism to be enormous gaseous systems; and the conjecture appears probable that their apparent permanence of general form is maintained by

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[‖] Mr. Huggins has already anticipated the above discovery in a paper communicated to the Royal Society on January 26 last, which we publish in this number.—Ed. C. N.

[*] Read before the Royal Society, January 26, 1865.

[†] "On the Spectra of Some of the Nebulæ." *Phil. Trans.*, 1864, p. 437.

[‡] The numbers and descriptions are from Sir John Herschel's Catalogue, *Phil. Trans.*, 1864, Part I.

[§] "The general aspect of the less luminous and cirrous portion is simply nebulous and irresolvable; but the brighter portion immediately adjacent to the trapezium forming the square front of the head, is shown with the 18-inch reflector broken up into masses, whose mottled and curdling light evidently indicates, by a sort of granular texture, its consisting of stars, and when examined under the great light of Lord Rosse's reflector, or the exquisite defining power of the great achromatic at Cambridge, U.S., is evidently perceived to consist of clustering stars. There can therefore be little doubt as to the whole consisting of stars too minute to be discerned individually even with these powerful aids, but which become visible as points of light when closely adjacent in the more crowded parts. . . . ."—Sir John Herschel, "Outlines of Astronomy," seventh edition, pp. 651, 612.

the continual motions of these denser portions which the telescope reveals as lucid points.

The opinions which have been entertained of the enormous distances of the nebulæ, since these have been founded upon the supposed extent of remoteness at which stars of considerable brightness would cease to be separately visible in our telescope, must now be given up in reference at least to those of the nebulæ the matter of which has been established to be gaseous.

It is much to be desired that proper motion should be sought for in those of the nebulæ which are suitable for this purpose; indications of parallax might possibly be detected in some, if any nebulæ could be found that would admit of this observation.

If this view of the greater nearness to us of the gaseous nebulæ be accepted, the magnitudes of the separate luminous masses which the telescope reveals as minute points, and the actual intervals existing between them, would be far less enormous than we should have to suppose them to be on the ordinary hypothesis.

It is worthy of consideration that all the nebulæ which present a gaseous spectrum exhibit the same three bright lines; in one case only, 18 H.IV., was a fourth line seen. If we suppose the gaseous substance of these objects to represent the "nebulous fluid" out of which, according to the hypothesis of Sir William Herschel, stars are to be elaborated by subsidence and condensation, we should expect a gaseous spectrum in which the groups of bright lines were as numerous as the dark lines due to absorption which are found in the spectra of the stars. Moreover, if the improbable supposition be entertained, that the three bright lines indicate matter in its most elementary forms, still we should expect to find in some of the nebulæ, or in some parts of them, a more advanced state towards the formation of a number of separate bodies, such as exist in our sun and in the stars; and such an advance in the process of formation into stars would have been indicated by a more complex spectrum.

My observations, as far as they extend at present, seem to be in favour of the opinion that the nebulæ which give a gaseous spectrum, are systems possessing a structure, and a purpose in relation to the universe, altogether distinct and of another order from the great group of cosmical bodies to which our sun and the fixed stars belong.

The nebulous star ι Orionis was examined, but no peculiarity could be detected in its continuous spectrum.‖

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 16.

Professor A. W. Williamson, *Ph.D., F.R.S., President, in the Chair.*

After reading the minutes and acknowledging the several donations to the library, the ballot was taken for Dr. William Johnson, Newcastle-upon-Tyne, and Mr. George Jones, 106, Leadenhall Street, London, each of whom was declared to be duly elected a Fellow of the Society. The names of the following candidates were read for the second time, viz.:—Capel H. Berger, Esq., Lower Clapton; Alexander W. Gillman, Esq., Southfield, Wandsworth; Arthur S. Hobson, Esq., Turnham Green; George B. Robertson, Esq., Stamp Office, Somerset House, and Upper Holloway; Robert Barton, Esq., Bushy Park, Teddington; William Chrispin, Esq., Darlington, Durham; William Judd, Esq., Christchurch, Hants; and Michael Foster, jun., M.D., Huntingdon. For the first time were proposed the names of Arthur Clegg Bowdler, Esq., Oxford Road, Manchester; and W. E. Heathfield, Esq., F.R.G.S., Princes Square, Finsbury.

Professor J. A. Wanklyn read a paper "*On Vapour-Densities.*" The author protested against the practice of employing a high temperature in experiments made for the purpose of determining the vapour-densities and formulæ of chemical compounds, on the ground that there was increased liability to decomposition, and when, as frequently happened, the results obtained at such high temperatures did not coincide with those taken at lower degrees of heat, there was no indication to show which number was entitled to be received with confidence. An extensive series of experiments had been made by Dr. Playfair and the author upon vapours heated to various points ranging between 10° and 40° C. above the boiling points of the corresponding liquids, and the conclusions established were to the effect that at the lowest possible temperature consistent with the production of truly gaseous vapours the results were one- or two-tenths higher than those furnished by the employment of superior temperatures. Some few substances, particularly sulphur and acetic acid, had vapour-densities which, taken at 40° C. above their boiling points, depart from the theoretical numbers by units instead of by tenths; and sometimes by heating the vapours of these substances still higher they become of the theoretical value. In other instances the superheating to the extent of 40° gave irregular results, and the vapours were found to be decomposed. The author then referred to his former experiments in which the vapour density was determined successfully by removing the pressure, instead of elevating the temperature, whilst the body was under examination; or, working on a practically identical system, he mixed the vapour with a known volume of a permanent gas, and thus obtained very accurate determinations. With reference to Cahour's maxim "Heat your vapour 40° C. above the boiling-point of the liquid," the speaker preferred to advise "that the determination be made at the lowest temperature that is practicable." Respecting the slight increase in the vapour-density observed whenever the vapour was heated only 5° or 10° above the boiling-point of the liquid, the author remarked that this increase was due not so much to any alteration in the co-efficient of expansion as to absorption by the walls of the vessel which was used to contain the vapour (Magnus). By way of explaining the anomalies observed in the instances of sulphur and acetic acid, the author suggested that each of these substances might be capable of combining with itself, and so producing complex bodies of different molecular weights. The existence of the element sulphur in several allotropic modifications seemed to favour this view; and he saw no difficulty in regarding acetic acid as a bibasic acid, and assigning to it a double formula; thus:—

$$\begin{matrix}C_2H_3\\C_2H_3\end{matrix}OO\begin{matrix}HO\\HO\end{matrix}$$

Acetic acid exhibits a tendency to form double salts with monatomic bases; it forms a compound with butyric acid —*i.e.*, butyr-acetic acid, an acid of great stability, and formerly mistaken for propionic acid. On the other hand, the state of condensation of chloride of acetyl and of acetic ether point to the existence of an acid having the formula C_2H_4OHO, which coincides with the result obtained on heating acetic acid vapour to temperatures above 200°C.

The arguments brought forward by Professor Wanklyn were warmly contested by the President, Professor Frankland, and by Dr. Odling, who also objected to the author's communication on the score of want of novelty.

A note "*On the Action of Chlorine upon Arsenious Acid,*" by Professor C. L. Bloxam, was read by the Secre-

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‖ Admiral Smyth appears to have always maintained that the results of telescopic observation on the nebulæ were insufficient to support the opinion that all these objects were probably of stellar constitution. See his "Cycle of Celestial Objects," vol. i., p. 316, and his "Speculum Hartwellianum," pp. 111-114.

TARY. The author attempted to prepare a large quantity of terchloride of arsenic by passing a current of chlorine gas over a heated mixture of arsenious acid and carbon, and was surprised to find that the product did not nearly amount to the calculated proportion. Upon examining the residue in the retort there appeared to be much arsenic acid formed, which the joint influence of carbon and chlorine was unable to decompose. This observation led to a closer study of the reaction, and the author found that the presence of carbon did not affect the result, and ultimately he arrived at the following conclusion—viz., that the action of chlorine upon arsenious acid at a moderate heat consists in the oxidation of one portion of arsenious acid at the expense of another, the arsenic of which is converted into terchloride, whilst the arsenic acid which has been thus formed combines with the remainder of the arsenious acid to form a transparent glass, having the composition $2AsO_3AsO_5$, which may also be produced by heating arsenic acid with an excess of arsenious acid. The result of Prof. Bloxam's quantitative experiments led him to adopt the following equation:—

$$11AsO_3 + Cl_6 = 2AsCl_3 + 3(2AsO_3,AsO_5).$$

The PRESIDENT remarked upon the interest of the reaction pointed out by Professor Bloxam, and recurring to the subject of vapour-densities, he was reminded of the anomalous result furnished by the vapour of arsenious acid, which occupied a double volume. Its constitution might be accounted for by supposing some of the metal to exist as a base, in the compound of four atoms of arsenic and six of oxygen.

Professor A. H. CHURCH, M.A., exhibited a fine specimen of the new mineral, Tallingite, on quartz, which he had received from Cornwall since describing the results of his analysis at the last meeting of the Society. He likewise showed a specimen of Melaconite, or native black oxide of copper, from Cornwall, which was so pure that it contained upwards of 99 per cent. of cupric oxide. The dark steel-grey crystals of this mineral belonged to a trimetric system, and were not monometric, as had been commonly supposed. For a fuller account of its mineralogical character we refer to Professor Church's note published last week in this journal (page 122).

Professor CHURCH finally made a statement respecting the action of nitrate of silver upon ebonite, to which his attention had been called by Mr. Hockin. Since this material had been applied to photographic use, and baths made of it were employed to hold solutions of nitrate of silver, it had been frequently noticed that the reaction of the neutral liquid became acid, and that a deposit, apparently of sulphide of silver, was formed on the interior surfaces of the ebonite vessel. Analysis gave 52 per cent. of silver and 8 per cent. of sulphur, in a portion scraped from the lining of a photographic bath, and these proportions nearly coincided with the numbers demanded for sulphide of silver. There were also traces of copper and other metals, but the most remarkable feature was the peculiar deflagration which ensued on heating the powder; sulphur vapours were given off, and spongy silver remained in the test-tube. (Mr. Church illustrated this point by an experiment.)

Mr. SPILLER said that he had examined many samples of ebonite with a view to their photographic application, and whilst he found some varieties behave in the manner described by Prof. Church, he had met with other samples of superior manufacture and purity which were proof against the action of silver solution of the strength commonly employed in the collodion process. He had always supposed the deposit to consist of pure metallic silver, and not the sulphide, and he believed the reduction of the metal to be due to the presence of metallic particles in the bronze powders and various pigments, commonly introduced into vulcanised india-rubber, from the refuse cuttings of which ebonite was frequently manufactured; but since Mr. Silver had, upon the speaker's recommendation, adopted the use of pure india-rubber and sulphur only in the production of ebonite for photographic purposes, the employment of such apparatus had gained in favour.

Professor FRANKLAND confirmed Mr. Spiller's observations with regard to the ordinary composition of ebonite. He had occasion, a year or two since, to examine a series of samples and experiment upon the manufacture. As the result, it was found that not only sulphur, but almost any metallic sulphide, was capable of hardening india-rubber when exposed to the proper temperature; the sulphides of arsenic and antimony could be used, and he succeeded in making ebonite, or vulcanite, containing as much as 20 per cent. of sulphate of magnesia.

The meeting then adjourned until Thursday evening, 30th instant, which will be the occasion of the Society's anniversary. The election of officers for the ensuing year and other business will be proceeded with at the usual hour, eight o'clock.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, March 7, 1865.

R. ANGUS SMITH, *Ph.D., F.R.S., &c., President, in the Chair.*

A PAPER "*On the Action of Sea Water upon certain Metals and Alloys,*" was read by F. CRACE CALVERT, Ph.D., F.R.S., F.C.S., &c., and R. JOHNSON, F.C.S., which we shall publish in our next.

Mr. JOHN ROBINSON exhibited specimens of iron and brass which had been acted upon by the water of the river Medlock, and stated he had found that an alloy of lead, tin, and antimony resisted the action of sea water better than any other metal or alloy he had tried

PHOTOGRAPHIC SECTION.

March 2, 1865.

Mr. JOHN PARRY *in the Chair.*

Mr. DANCER read a paper entitled, "*The Opaque Microscope not New,*" in which he proved that the so-called new instrument was of very old date, and was described and used previous to the year 1780; and that an improved form of it was exhibited nightly at the Manchester Mechanics' Institution in the winter of 1840—1841.

Mr. SIDEBOTHAM exhibited some prints taken by the Wothlytype process, and described the mode of their production. Others printed by the ordinary silver process from the same negatives were also exhibited, and pronounced to be superior in every way.

Mr. BROTHERS exhibited two photographic prints taken by Mr. Pouncy, of Dorchester, one of them obtained direct from the negative in printers' ink, the other printed from stone. Mr. Brothers also exhibited, with a copying camera, the mode of obtaining photographs of microscopic objects by burning magnesium; also a negative and a print from it of an insect dissection so enlarged.

ACADEMY OF SCIENCES.

March 13, 1865.

M. CHEVREUL continued and finished his historical account of the ideas entertained respecting air before the complete discovery of oxygen. In this paper he reviews the ideas and experiments of Priestley, Scheele, and Lavoisier, giving to the first, without qualification, the praise of being the first to recognise and determine the properties of oxygen. He next details with great fairness the various discoveries—too little known—of Scheele, "the humble pharmacien of a small town in Sweden;" and lastly comes to Lavoisier, who settled beyond dispute the composition of the air, and enunciated the theory of combustion.

M. Berthelot continued his paper "*On the Calorific Phe-*

nomena which Accompany the Formation of Organic Combinations," treating in this of the formation of aldehyds, acids, ethers, amides, &c. We leave this paper for a longer abstract than we can give here.

M. Menschutkin presented a note "*On the Acetopyrophosphates.*" The author has already described acetopyrophosphorous acid, which he has since attempted to oxidise by means of nitric acid. By this reaction he only obtained a white crystalline mass, which he could not analyse. He therefore had recourse to another oxidising agent,—peroxide of hydrogen—by which the desired result was accomplished.

$$P_2(\mathrm{C}_2H_3\Theta)H_3\Theta_5 + H_2\Theta_2 = P_2(\mathrm{C}_2H_3\Theta)H_3\Theta_7 + H_2\Theta.$$

The method adopted for the preparation of the baryta salt was as follows:—Peroxide of barium was dissolved in just enough dilute hydrochloric acid to give a clear liquid; a solution of acetopyrophosphite of potash was then added, and after a time a crystalline precipitate fell, which proved to be the baryta salt desired. The salts of silver and lead were prepared by means of the baryta salt.

By long boiling with ether acids or alkalies acetopyrophosphoric acid is converted into phosphoric.

M. Salet presented a short note "*On the formula of Liquid Chloride of Cyanogen.*" To this body, discovered and described by Wurtz eighteen years ago, the discoverer first attributed the formula Cy_2Cl_2, which he subsequently halved. The author of this note has made careful determinations of the vapour density, in which he finds no irregularities, and which correspond exactly to the theoretic density required by the formula CyCl. M. Salet remarks that Serrullas' gaseous chloride of cyanogen, to which the formula CyCl is also attributed, presents with the liquid chloride a curious example of isomerism.

M. Maisonneuve exhibited and described *a new form of lithotrite*, or *lithotribe*, as he has named it. One arm of this instrument is hollow, and thus at any stage of the operation water can be injected into the bladder without removing the instrument. It is, of course, equally possible to distend the organ with a gas, as carbonic acid, when liquids set up much irritation.

Botanists will find in this number of the *Comptes Rendus* an interesting paper "*On the Lacticiferous Vessels of the Papaveraceæ.*"

NOTICES OF BOOKS.

Report on the Air of Mines and Confined Places. **By Angus Smith, Ph.D., F.R.S. Part of the Appendix to the Report of the Royal Mines Commission. 1864.**

[Second Notice.]

Out of doors it is found that the proportions of oxygen and carbonic acid vary but slightly from what we have called the normal standard. Within inhabited houses, places of amusement, &c., as might be expected, greater differences are observed. Leblanc was one of the first experimenters who entered upon the examination of the air of houses, theatres, &c., and remarked in these the diminution of oxygen and the great increase of carbonic acid. We need not quote the results at length, which show us that in the air of a bedroom he found more than one per cent. of carbonic acid (by weight), and in the Opera Comique 0·43 per cent. We may come nearer home, and see what Dr. Smith himself found in Manchester and Dr. Bernays in London. In the pit of the Theatre Royal of Manchester Dr. Smith found 0·27 per cent., and at the ceiling of his own study 0·156 per cent. of carbonic acid. In the pit of the Standard Theatre, London, Dr. Bernays found 0·32 per cent., and even in an office in Chancery Court, at three feet from the ground, 0·2 per cent. (by volume). Pettenkoffer made many analyses of the air of inhabited places in Munich, and found as much as 0·536 of carbonic acid in some. He also studied the effects of breathing air so contaminated, and came to the conclusion that "1 per 1000 marks the limit of good and bad air, and that those who can plead for more have lost the refined use of their senses." The ill effects, however, cannot altogether be ascribed to the carbonic acid, but to the offensive organic emanations which invariably accompany it. The depressing feeling that arises from breathing such air, he attributes to butyric and valerianic acids which are present in such an atmosphere. With these remarks let us pass to the air of mines.

Dr. Smith first reviews the labours of his predecessors. We notice at starting the experiments of Mr. Moyle on the air of the Cornish mines. He collected the air by emptying bottles of water, and thus, Dr. Smith believes, must have lost some carbonic acid. Dr. Smith therefore recalculates the results, giving an amount of carbonic acid equal to the oxygen removed, and thus arrives at the conclusion that in these Cornish mines the proportion of oxygen varied from 19·34 to 15·51 per cent. Here is a serious diminution; and Mr. Moyle remarked that in the last specimen a candle burned with difficulty. Mr. Robert Hunt has also made some analysis of the air of Cornish mines, finding in some as little as 17 per cent. of oxygen.

Brockman and Bodeman have examined the air of the Upper Harz Mines, and their experiments yielded the following average results:—

Oxygen.	Carbonic Acid.
19·79	1·39

Dr. Smith's analyses extend to many hundreds, but before giving his results we will quote at some length his method. The specimens were collected in tubes three-quarters of an inch in diameter and six inches long, drawn out at each end. Air was drawn through them by means of a bellows' aspirator, and then the tubes were sealed. To make sure that the sealing was good, the ends were examined by a lens or dipped under mercury. Removed to the laboratory, the sealed ends were broken under mercury, and the air transferred to an absorption tube. The carbonic acid was then absorbed by a moist ball of caustic potash. In general, Dr. Smith found that in twelve hours the absorption was complete. At first he determined the oxygen by means of pyrogallic acid, but afterwards gave the method up because of the difficulty of washing the tubes from the strongly coloured liquid, and the probable error from the production of carbonic oxide. He then resorted to the method by explosion, using Bunsen's eudiometer, and exploding with a small Rhumkorff's coil, and in this way got quickly through an immense number of analyses. The accuracy of these were conscientiously tested, and thus Dr. Smith is able to say that the determinations of oxygen he believes to be correct to a small fraction. The same minute accuracy, however, is not to be expected in the carbonic acid. "The amount being extremely small, and the amount of air being extremely small, there was more risk of error."

The results of all these analyses are given in a table of great length. It will be sufficient for our purpose to quote the summary.

Summary of Analyses.

Oxygen, average of 399 experiments	20·26
" of ends	20·18
" of other parts	20·32
" in currents	20·65
" in large cavities	20·77
" just under shafts	20·42
" in sumps	20·14
Carbonic acid	0·785

35, or 10·67 per cent., normal, or nearly so.
81, or 24·69 per cent., decidedly impure.
212, or 64·63 per cent., exceedingly bad.

We have already explained that Dr. Smith considers normal air to contain 20·9 of oxygen; that containing

20·6 he considers decidedly impure; and 20·5 he sets down as exceedingly bad and dangerous.

Dr. Smith then proceeds to the causes of this deterioration of the atmosphere in mines.

(To be continued.)

Cooley's Cyclopædia of Practical Receipts, &c. Fourth Edition, Revised and Enlarged by Arnold J. Cooley and J. C. Brough. London: John Churchill and Sons. 1864. Pp. 1393.

The progress of chemistry, pharmacy, and technology during the past few years has rendered the publication of a new edition of this well-known work a matter of necessity. Cooley's "Cyclopædia," in its old form, is too well known to most of our readers to need any description or praise from us; we shall, therefore, limit our remarks upon it to pointing out the improvements and additions it has received from its old editor, Mr. Cooley, and from his worthy successor, Mr. J. C. Brough. In the preface we are told that the articles under the letters A and B were written entirely by the first-named gentleman, but that owing to general ill-health and a frightful accident, Mr. Cooley was unable to continue his task. The remainder of the book was therefore placed in the hands of Mr. Brough for completion.

Amongst the general improvements the work has received may be mentioned the increased size of the pages, which contain about 25 per cent. of additional matter, the margins of course being proportionately smaller. Besides this, the number of pages has also been increased. The type in which the work is printed has been judiciously altered, the catch words being in a thickened letter, and several different signs are used to denote where synonyms are obsolete, colloquial, or vulgar. These typographical aids to ready reference will be appreciated by the man of business, who has but little time to spend in hunting up the words he requires.

Turning to various articles as tests, we find that many important words, such as "acidimetry," "alkalimetry," and "alcoholometry," have been greatly enlarged, the table of the real strengths of spirituous solutions at different temperatures under the latter word being most elaborate. Under Alkaloids we find Stas's and Fresenius's methods of detection and extraction given at great length. "Carbolic acid," "collodion," and "crucibles" also receive special attention. The article on Dialysis is a little essay on the subject, and deserves republication. Under Equivalents, a table giving the old and new formulæ of all the more common chemical compounds will be found. The following articles, taken at random, are also greatly enlarged, the latest information being given on the subjects of which they treat:—Furnaces, Hypophosphites, Lamps, Iodine, Safety Matches, Chlorodyne, Phosphorus, Pyroxylin. As a specimen of the care which has been taken to bring the information conveyed in the work down to the present day, we may mention that the following words all receive full attention:—Cæsium, dialysis, leucaniline, rubidium, spectral analysis, thallium, and many others of less importance.

The British Pharmacopœia made its tardy appearance too late to receive a due amount of attention in the body of the book. Rather, therefore, than wait for its advent, the editors wisely chose to convey the information published in that much-abused work in the form of an appendix. This has been done with great care by Mr. Brough, who has cleverly contrived to put the matter into the smallest possible space.

We feel sure that little more need be said to convince our readers that the present edition is a most worthy successor, both in quality and quantity, to the preceding ones; and the editors deserve the greatest praise for the painstaking and judicious manner in which they have put a new face on an old friend.

A Suggestion as to the Feeding of Milch Cows, with a view to Improvement in the Constituents of the Milk. By Humanitas. London: Booth. 1865.

That the nature of the food to some extent alters the milk of the cow there can be no doubt. Nature intended cows to feed on grass, and we question whether any improvement can be made on that diet. A London cow, fed on sour grains in a dark cellar, cannot be expected to yield milk of the same quality as one that roams and feeds at will in the open air. Some improvement in the food of London cows might, no doubt, be made, and the suggestions of the author may deserve attention.

With regard to the composition of human and cow's milk, the writer may perhaps be somewhat enlightened by a perusal of the article "Milk," in the last number of "Watts' Dictionary of Chemistry." It will there be seen that the differences are not so great as seems to be imagined.

Journal für Praktische Chemie. Nos. 23 and 24, 1864.

This double number of the Journal completes the volume for 1864. It opens with an article by F. J. Ruprecht, "*On the Origin of Tschornosjom*," the black earth, of wonderful fertility, which covers about a third of Russia in Europe. Geologists, chemists, and microscopists have at different times sought to explain the origin of this deposit, but without success. The chemist finds an unusually large proportion of humus, with potash, soda, and as much as ½ per cent. of phosphoric acid. The microscopist finds no traces of marine organic forms (which is conclusive against its having formed the bottom of a sea), nor of vegetable organic structure, but observes numbers of the phytolithites which commonly occur in grasses. The author of this paper seems to consider that the earth results from the complete decomposition of grass sod.

Another contribution from Russia is a short notice by J. Tuttschew, "*On some Naphthas sold in Kieff*," both of American origin. There is nothing to be noticed in the account of these, but an experiment deserves mention. The author passed the vapour of one, to which he attributes the formula C_4H_4, through a red-hot tube filled with pumice stone, and obtained a quantity of gas and a tarry residue. A gramme of the naphtha yielded about a litre of gas, which had the following volume percentage composition:—

Acetylene	1·77
Elayl and homologues	20·51
Residue (marsh gas and hydrogen)	77·72

A paper by Leuchs, "*On the Nutriments of Yeast and their Relative Value*," details a number of experiments undertaken to discover upon what food, and under what circumstances, the yeast plant becomes most developed. We need not quote much of the paper, but it may be useful to some to know that a solution of twelve to fifteen parts of sugar in a hundred parts of water is most advantageous for fermentation.

A long paper by Borodin, "*On the Action of Sodium on Valeraldehyd*," is thus summed up by the author:—

1. By the action of sodium on valeraldehyd hydrogen is expelled: the substance containing sodium which is formed, is not a simple substitution product, but a mixture.

2. Water decomposes this mixture.

3. Among the decomposition products valeraldehyd is again found with isomeric and polymeric bodies, accounting for the absence of valeraldyhate of sodium in the original substance.

4. The decomposition products are probably caustic soda, valerianate of soda, amyl-alcohol, and two new bodies, $C_{10}H_{22}O$ and $C_{10}H_{18}O$.

5. The valerianic acid is formed at the expense of the oxygen of the aldehyd, and is not a by-product of the oxidation of the aldehyd in the air.

6. The body $\mathrm{C}_{10}\mathrm{H}_{22}\mathrm{O}$ is a monatomic alcohol identical with, or an isomer of, caprinic acid.

7. $\mathrm{C}_{10}\mathrm{H}_{18}\mathrm{O}$ is a neutral body, the chemical nature of which is yet undetermined, but which appears to contain replaceable hydrogen.

"*On the Salts of β-nitrobenzoic Acid, and the Action of Zinc on their Ammoniacal Solutions,*" is a short paper by Solokoff. The reaction mentioned yielded Zinius' azobenzoic acid.

Dr. Hahn, in a paper "*On the Compounds of Selenium with Phosphorus,*" describes a number of definite compounds of these two bodies, and some double compounds with metallic selenides.

The next article is by Dr. Classen, "*On the Salts of Tetrethyl-ammonium Oxide with Oxidizing Acids, and their Decomposition Products on Destructive Distillation.*" The author experimented with the tungstate, molybdate, stannate, antimoniate, chromate, arseniate, &c. The three last-named salts, on dry distillation, yielded aldehyd, and some gave alcohol and acetic acid, the formation of which is easily explained. The molybdate, tungstate, and stannate gave neither.

Schönbein, in a paper "*On the Proximate Cause of the Alkaline Fermentation of Urine,*" points out the existence of a ferment in normal urine, and shows that the thread-like fungus which deposits in stale alkaline urine is, after well washing, capable of immediately setting up the change in fresh urine. The odour of decomposing urine he believes to arise from the decomposition of a sulphur compound, a natural constituent of the fluid already noticed by Stadeler and Pettenkofer.

The short notice of a paper by Professor Gerlach, "*On the Photographic Representation of Injection Preparations in their Natural Colours,*" mentions a method by which the author is said to obtain naturally coloured pictures, and we shall return to it again.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

2748. A. Estourneaux and L. Beauchamps, "Certain improvements in non-conducting composition for preventing the radiation or transmission of heat or cold."—Petition recorded Nov. 7, 1864.

2969. M. A. F. Mennons, Rue de Dunkerque, Paris, "Improvements in hot blast furnaces."—A communication from N. de Telescheff, St. Petersburg.—Nov. 29, 1864.

512. W. E. Newton, Chancery Lane, "An improved mode of preparing fertilising compounds or artificial manures."—A communication from G. A. Leibig, Baltimore, U.S.A.

515. A. Meyer and M. Meyer, Liverpool, "Improvements in preparing explosive compounds."—A communication from W. Gerhardt, Schnackenburg, Hanover. —Feb. 23, 1865.

516. J. Jacob and R. Pilzinger, Dudley, "Improvements in the method of and apparatus for generating heat."

528. J. Nicholas, Aspull, Lanchashire, "Improvements in converting coal oil into gas suitable for use as an illuminator."—Feb. 24, 1865.

532. T. Routledge, Sunderland, and T. Sutherland, Newcastle-upon-Tyne, "Improvements in the treatment and utilisation of certain products obtained in the manufacture of paper or paper stock."

534. F. Claudet, Coleman Street, London, "Improvements in the preparation of certain iron ores or residues for use in the blast furnace."—February 25, 1865.

546. G. K. Geyelin, South Hackney, "An improvement in air-tight jars for preserving eggs and fruit, and such like articles of food."—February 27, 1865.

564. J. Fordred, Blackheath, Kent, "Improvements in treating certain hydrocarbon oils, and in vessels for containing the same."—February 28, 1865.

571. J. Young, Manchester, "Improvements in distilling bituminous substances, and in apparatus employed therein."

572. G. H. Barth, Highfield Villas, York Road, St. Pancras, "Improvements in condensation and refrigeration of vapours and fluids."

574. C. J. Falkman, St. Petersburg, "Improvements in apparatus for distilling, purifying, and storing spirituous liquors."—March 1, 1865.

NOTICES TO PROCEED.

2704. W. Smith, Salisbury Street, Strand, "Improvements in tanning leather, and in the apparatus to be employed for that purpose."—A communication from Mons A. Jullien, Nantes, France.—Petition recorded November 2, 1864.

2719. C. H. Garton, Bristol, and Thomas Hill, Southampton, "Improvements in brewing, fermenting, racking, and bottling beer, ale, and wine."

2723. H. W. Spencer and J. E. Ball, Willow Terrace, Bermondsey, "An improved method of manufacturing glue and size."—Nov. 3, 1864.

2733. F. Yates, Birmingham, "Improvements in the manufacture of steel and malleable cast iron, and in apparatus to be used in such manufacture."

2734. F. Yates, Birmingham, "Improved apparatus for generating combustible gases."—Nov. 4, 1864.

2762. A. Field, Lambeth Marsh, "Improvements in the manufacture of night-lights."—Nov. 7, 1864.

2766. R. Rimmer, Crowe Hall, Suffolk, "Improved apparatus for drawing off liquids."—Nov. 8, 1864.

2785. J. Dale and H. Caro, Manchester, and C. A. Martins, Warrington, "Improvements in obtaining colouring matters for dyeing and printing."—Nov. 9, 1864.

2788. J. A. Manning, Inner Temple, "Improvements in the collection and treatment of night soil."—Nov. 10, 1864.

2858. M. Destrem, Rue Lamartine, Paris, "An improved composition for painting."—Nov. 21, 1864.

3073. J. Ramsbottom, Crewe, Cheshire, "Improvements in the manufacture of steel and iron, and in the apparatus employed therein."—Dec. 12, 1864.

3115. W. Bardwell, Great Queen Street, Westminster, "An improved method of utilising sewage and urine, and for facilitating their passage through pipes, thereby preventing the pollution of rivers and streams."—Nov. 16, 1864.

3160. H. Bird, Berkeley Street, Cheltenham, "Improvements in treating sewage matters."—Dec. 20, 1864.

173. J. Hewes, West Bromwich, "Improvements in puddling, heating, and other reverberatory furnaces used in the manufacture of iron and steel, and for other purposes, which improvements may also be applied to steam boiler furnaces."—Jan. 20, 1865.

374. E. Leigh, Manchester, "Improvements in furnaces for smelting iron ores, commonly called blast furnaces, also in cupolas used in foundries for rendering down or melting iron or other metals."—Feb. 10, 1865.

473. J. G. N. Alleyne, Butterley Ironworks, Alfreton, Derbyshire, "Improvements in puddling furnaces, and in apparatus connected therewith."—February 18, 1865.

Royal Institution.—The following are the arrangements for the ensuing week:—Tuesday, March 28, at 3 o'clock, Professor Masson, "On Recent British Philosophy." Thursday, March 30, at 4 o'clock, Charles Newton, Esq., "On Recent Acquisitions to the British Museum from Rhodes, &c." Friday, March 31, at 8 o'clock, James Glaisher, Esq., "On Aerial Researches." Saturday, April 1, at 3 o'clock, Professor Marshall, "On the Nervous System."

CORRESPONDENCE.

Continental Science.

Paris, March 22.

The French are in general a sceptical nation, but there is one thing in which most Frenchmen firmly believe, and that is, in the possibility of flying through the air like a bird. It is of no use that M. Babinet and other philosophers learnedly set before them the difficulties in the way of a body heavier than air rising in that medium; they see those difficulties overcome in a hundred ways every day. Sufficient force properly applied is all that is wanted to overcome gravity and establish equilibrium in the air. Heat is, of course, the force to which every one looks for support, but how to apply it? M. Landelle proposes to apply the principle of the screw, but I do not think he has yet raised himself above the ground. M. de Groof, too, has a machine in hand, nearly finished, and the completion of which is only delayed by the difficulties unavoidable in the construction of entirely new apparatus. In the meantime, M. Menuisier and other experimenters have fallen back upon first principles, and made gigantic wings of feathers, by means of which they have really, by their own strength, raised themselves in the air—*quelques centimetres*—say, an inch or so! Who, then, can question the possibility of human *aviation?* Still, the result is not great, and some enthusiasts have placed 5000 francs at the disposal of the Société dé Encouragement as a prize for the inventor who shall discover a method of travelling in the air by means of apparatus heavier than air.

From the regions of the air and speculation I may descend at once to the depths of the ocean, and call your attention to the ideas of MM. Pelegrin and Gabeiron, who propose a light and cheap cable for ocean telegraphy. Light cables have hitherto failed, or rather, have not been successfully laid; but the authors propose one perfectly flexible, to be sunk by weights attached at intervals as it paid out, and so contrived that they release the cable when at the bottom. Seeing, too, that heavy cables have been broken in the paying out by the strain and weight, they suggest for these a series of floats, which will take off much of the strain and allow the cable to sink gradually. These ideas are, perhaps, worthy the attention of ocean telegraphists, and you will find them at length in *Les Mondes* for the 16th of this month.

In the same journal you will find a mention of a new commutator, by means of which if you have a battery of twenty or more cells at work, you may make use of two, four, or indeed any number of couples. The thing has been patented in England, so it would be useless to describe it fully, but I may say that it consists of a wooden cylinder covered with bands of copper, which are numbered, and so arranged that each number is brought into connexion with the same number of cells. So when all your connexions have been made you have only to turn the cylinder, and without touching the battery you can use just as many cells as you please.

While on this matter, let me tell you that you may soon expect a revelation. The question "What is electricity?" is generally replied to one with the simple answer "It is electricity." We know of various manifestations of the force, but as to its nature all have hitherto been silent. M. Baille, however, has thought over the matter, and strongly hints that he is able to explain what electricity is. I shall be glad to see his explanation.

I see a very useful contrivance described by Erlenmeyer for managing the application of heat in the distillation of liquids with high boiling-points. A sand-bath, as everybody knows, is a very inconvenient arrangement, and a clay-coated retort is often out of the question. The Doctor therefore suggests surrounding the retort with short fibres of asbestos, which he keeps in their place by means of a wire gauze. Such an asbestos bath appears to me very simple, and will no doubt be perfectly efficacious.

In my last I showed you how a tape-worm might possibly conduce to the enjoyment of a man well provided with the means of filling his stomach. But every one is not so well provided. Chamfort said with much truth that society is composed of two great classes—those who have more dinner than appetite and those who have more appetite than dinner. The latter class clearly can have no enjoyment with a tape-worm, so they may rejoice to know that it is easy to get completely disembarrassed of the parasite. A dose of ether administered in a capsule or in some syrup produces anæsthesia in the worm, who in this state relaxes his hold of the mucous membrane, and is swept away into the rectum, from which he is effectually dislodged by a small dose of castor oil. The dose of ether (60 grammes) looks large, but M. Lortet does not say that any evil consequences follow, while the anthelmintic effect is certain.

Perhaps some reader of the Chemical News is fond of artichokes. I am myself; but I always complain that it is an expensive *plat*, because there is so little of them to eat. This, however, it seems, can be remedied, and I give you the means by which their size may be greatly increased, and all the leaves made edible. When the head (or bottom) attains the size of an egg, a deep incision is made into the stem. This, it is said, arrests the development of the fruit, while the leaves go on increasing in size; and now, to get the whole white and soft, you have only to sentence the plant to partial death by putting a black cap on the head.

In whatever art or science England may be behind, she more than holds her own in photography. The photographic journals here are mostly filled from English sources, and English processes are generally adopted. At the last sitting of the Photographic Society, M. Loewe sent a description of a new process of heliographic engraving, but forwarded no proofs by which the value of it could be decided. It looks a hopeful process, so I send it.* At the same meeting, MM. Marechal and Motay exhibited a collection of vitrified proofs and photolithographic prints, but did not describe their process because the English patent was not then completed. You will hear of it soon from another source.

M. F. Thomas read a note giving a process for the *estimation of chloride of platinum in chloride of gold*, which he says is extremely simple. To a solution of the suspected salt he adds a solution of nitrate of silver drop by drop as long as a precipitate is produced. The precipitate consists of chloride of silver and auric acid, and any platinum will be in solution. This, therefore, is to be boiled, saturated with carbonate of soda, and the platinum precipitated as a chloroplatinate by means of sal ammoniac. The mixed precipitate of chloride of silver and auric acid is to be boiled in nitric acid, and then treated with aqua regia, which dissolves the gold, and leaves the chloride of silver. The gold solution diluted is then boiled with excess of oxalic acid.

The Supposed New Gunpowder.

To the Editor of the Chemical News.

Sir,—There is a great noise being made just now by the correspondence going on in the various naval and military journals about a celebrated discovery by a German chemist named Dr. Erhardt of a new gunpowder, for which a patent has been applied for.

My suspicion being excited, I waited for further information thereon, but the specification given in the *Times* of the 6th shows that it is none other than my own invention of 1857 revived, and which I had previously submitted to our Government, and at length published in the Chemical News for August 16, 1862, composed of chlorate

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* We shall give it next week.

of potash and powdered galls, which was proposed as a safety powder, to be kept in a separate incombustible state till wanted. So much for this so-called new German discovery. Is it not sickening to scientific men to see their inventions so appropriated by others? Being published, it cannot be patented. I am, &c.

JOHN HORSLEY, F.C.S.

The Laboratory, Police-station, Cheltenham, March 13.

On the Carbonate of Magnesium and Ammonium.

To the Editor of the CHEMICAL NEWS.

SIR,—Allow me to correct a slight error occurring in Mr. E. Sonstadt's paper, "On a New Reagent for the Separation of Calcium from Magnesium," which appeared in the CHEMICAL NEWS of the 3rd inst. The "special notice" on the carbonate of ammonium and magnesium to which Mr. Sonstadt refers in the following passage was communicated by myself to the Chemical Society:—

"When, in the ordinary course of qualitative analysis, carbonate of ammonium is used to separate calcium from magnesium, unless the former is present in notable proportion to the latter, a very insoluble double carbonate of magnesium and ammonium always accompanies the carbonate of calcium, if this is allowed sufficient time to form. If much magnesium and no calcium is present, the magnesium precipitate still falls after awhile. . . . This fact is cursorily mentioned by Fresenius, more fully by Gmelin, and has recently been made the subject of a special notice by Dr. Dyer."

I take the present opportunity to draw attention to the statements which still occur in text-books of recent issue, to the effect that carbonate of ammonium does not precipitate magnesium salts in the presence of chloride of ammonium, in spite of the assertions to the contrary in the last edition of H. Rose's "Analyse Qualitative," the last English edition of Fresenius' "Qualitative Analysis," and in my own paper. Indeed, this error, so easily tested by experiment, is emphasised by italics in the last edition of Fownes' "Manual." The precipitation is remarkably near completeness, for phosphate of sodium gives only a faint precipitate in the mother liquor. It commences in a few minutes, varying according to the strength of the solution and the extent to which agitation is practised.

In my communication I neglected to mention the influence of a large excess of ammonia solution upon this precipitation: I may now state that the strongest solution added in great excess serves only to quicken it.

Carbonate of magnesium and ammonium is prepared with the greatest ease in large quantity by adding a solution of carbonate of ammonium to a mixed solution of sulphate of magnesium, chloride of ammonium, and ammonia, as described in my paper, yet no mention is made of this salt in the recent edition of one of the leading English text-books, although the carbonate of potassium and magnesium, instable and somewhat difficult to prepare as it is, receives due notice in it.

This interesting salt is also a ready source of normal carbonate of magnesium in any quantity, for the double salt requires simply to be digested for a few minutes with water to yield it in a dense and crystalline form, pure if freed from the mother liquor by washing. It is, therefore, a much more eligible source of carbonate of magnesium than the solution of *magnesia alba* in carbonic acid water, or the mixture of sulphate of magnesium and carbonate of sodium enclosed in sealed tubes.—I am, &c.

EDWARD DIVERS, M.D.,
Prof. Mat. Med., Qu. Coll., Birmingham.

5, Mildmay Park Terrace, Stoke Newington, N., March 13.

Royal Institution.—This evening, Friday, March 24. Professor Westmacott, R.A., F.R.S., "How Works of Art should be Looked at."

MISCELLANEOUS.

Chemical Society.—The anniversary meeting of this Society will take place on Thursday evening next, at 8 o'clock.

Titanuretted Hydrogen.—In a letter to the Parisian journal *Cosmos*, Dr. Phipson announces that he believes he has formed titanuretted hydrogen by the action of magnesium on titanic acid. The author promises shortly a detailed account of the results of the action of magnesium on titanic, tungstic, molybdic, and other metallic acids.

Dyeing of Mixed Tissues.—Prepare a bath of salt of iron from 1° to 8°, acetate of iron for instance, heat it to from 60° to 65°, soak the material in it for two hours, which next rinse in running water, and it is then ready for dyeing. Prepare the dye bath with the same salt of iron with the addition of extract of logwood, maintain the temperature at 40° or 50°, bathe the material in it for fifteen or twenty minutes, and then boil it for an hour. Remove the pieces, add a small quantity of salt to the bath, boil for another hour, and the dyeing will be complete. This process dyes black mixed animal and vegetable fibres, either fleece, carded, combed, spun, or woven. By varying the mordant and the extracts different colours are obtained. It is especially applicable to the dyeing of *renaissance* tissues, obtained by unravelling scraps of wool mixed with cotton. Scraps of wool, which were formerly used as manure or in the manufacture of Prussian blue, are now collected for unravelling. In the inferior scraps the wool may be separated from the cotton and the cotton from the wool. The action of hydrochloric acid disaggregates the cotton, and leaves the wool (not exactly intact, as it becomes harsh and refuses to felt). The action of soda or sulphide of sodium dissolves the wool and leaves the cotton, which may be used in paper-making, while the dissolved wool may be used for manure.—*M. Grison, Bulletin de la Société Chimique.*

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. X. of the CHEMICAL NEWS, containing a copious Index, is now ready, price 11s. 0d., by post, 11s. 6d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. XI. commenced on January 6, 1865, and will be complete in 26 numbers.

Mr. Newland's communication is unavoidably postponed until next week.

A Subscriber.—If your object is to clarify the solution, mix a little white of egg, and boil; or you might filter the fluid while hot.

W. G. (Cowlairs.)—We know of no work treating of either subject. The second is a matter for individual experiments. The oil could, of course, be separated by the addition of an acid and boiling.

M. W. writes:—"I have read with interest Dr. Adriani's papers on cotton-seed oil and its purification, and notice Mr. Blockey's letter in your number of 10th inst. Perhaps Mr. Blockey will explain his mode of purifying the oil, if it is not a trade secret."

C. R. writes:—"Can your correspondents explain whether truth is in the common notion that strong sunshine checks fires in grates; and if so, by what force?"—It is an optical delusion, dependent upon the much greater brilliancy of sun-light over fire light.

Spectrum Analyst.—The spectroscope is the natural development of the discoveries of Newton, Wollaston, Fraunhofer, and others. It would take an entire CHEMICAL NEWS to answer the rest of our correspondent's questions, solutions to which he can easily obtain by reading our back numbers.

Al Chemicus.—Reflected light is always more or less polarised, but apart from that there is no means of distinguishing it from transmitted light. The Royal Society fund is not intended to aid amateur experimenters, but to relieve persons of known attainments in distress. If you communicate matters of special interest to the Society, you may get a grant towards further investigations.

THE BILLS FOR REGULATING THE QUALIFICATIONS OF CHEMISTS AND DRUGGISTS.

We feel bound to say that a fuller acquaintance with the bill of the United Society does not increase our respect for the measure. We have said that it seemed to provide cumbrous machinery for effecting simple objects, but on looking more closely into the matter the machinery seems shadowy rather than cumbrous, while some of the provisions of the bill—clause 16, for example —are decidedly unjust. The United Society itself appears to be yet in the nebulous state; the bill indicates gaseity in the body from which it emanates, and which is at most resolvable into but one discrete (not *discreet*) point. The condensation of this vapour is to be effected at a public meeting of the whole trade, convened by advertisement, and presided over by a Government Commissioner, who may decline to ratify, and so stultify, the whole proceedings. This alone, we take it, is sufficient to ensure the defeat of the bill. The only chance the Society had was exhibiting itself in a position to commence operations at any moment, ready provided with an executive capable of carrying the provisions of the bill into effect. Instead of that, all has to be evolved from the chaos of a public meeting, to which all chemists from John O'Groats to the Land's end are to be invited by advertisement. We do not believe that any such meeting would fairly represent the trade, and should be very sorry to see the experiment tried.

Regarding it as impossible that both bills can be passed, we need not stop to point out the inconvenience and confusion which would ensue from such a result. Any one who has taken an interest in medical politics, must have seen the evils that have resulted from a multiplicity of examining and licensing bodies. Our own views on the subject of licenses are tolerably decided, and we may briefly state them. We believe that the power of licensing to practise in any profession or trade should reside solely in the State, which might fairly make the licenses a means of direct taxation. To obtain the license a minimum examination should be passed. If any one, say a chemist and druggist, should wish for some scientific distinction, he might go the London University, and become a Bachelor of Science; or if he belonged to the medical profession, he might go to any other body that confers a title, if he could find one whose title he could feel proud of possessing. But in the light of past events, such a scheme seems Utopian, and we must accept things as they are. Under these circumstances, we would press the acceptance of the Bill of the Pharmaceutical Society, subject to the amendments we mentioned last week. The first of these is that all registered chemists and druggists be admitted to the full privileges of Pharmaceutical Chemists. There is that unfortunate difficulty of the Juries' Act to which we must allude. We never supported that measure when it was before Parliament. It was carried upon false pretences. The fact is that the majority of the members of the Pharmaceutical Society are in a position to employ assistants as intelligent and trustworthy as themselves, and no one is likely to suffer from their absence on a jury. It is the unhappy chemist and druggist, whose means will only allow him to employ an errand boy—gifted possibly with the perverted understanding described by Mr. Dickens —it is this man's business that suffers by a week's absence of the proprietor at the assizes twenty miles away, and it is in his establishment, if in any, that life is jeopardised. And such a man gets no relief under the Bill, although much more entitled to it than a London pharmaceutical chemist with half a dozen competent assistants behind his counter. Nor is the public protected in the only quarter in which it needs protection. We see no way out of this difficulty but in recommending Sir George Grey to bring in a short Bill to render chemists and druggists or pharmaceutical chemists—we use the terms as convertible—liable to serve as jurymen in special cases, such as patent disputes, poison trials, and coroners' inquests, in which the knowledge they are supposed to possess might assist in the administration of justice.

Passing from that, however, we again urge that the *whole* trade in drugs and poisons should be under control. Some weak objections to this might be easily overcome by drawing up a schedule of simple domestic medicines which village shopkeepers might be allowed to retail with perfect safety, while it would prevent them from dealing in active and dangerous substances.

We intended to offer some remarks on that part of the Bill of the United Society which relates to the examination of chemists and druggists, but the limited space we can devote to discussions of this kind compels us to defer these for the present.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On Cobaltic Acid.[*]

The existence of cobaltic acid, which has long been suspected, seems to be proved by M. Winkler's experiments. According to him, by boiling different cobalt products, but more especially the metal in powder, with a concentrated solution of caustic potash, an intensely blue liquid is obtained, containing cobaltate of potash.

The proper proportions seem to be one part of metal in a spongy state (produced by the reduction of protoxide by means of hydrogen or starch), one part of caustic potash, and three of water; the boiling is continued until the dark blue colour is produced, after which the mixture is filtered through asbestos.

Cobaltate of potash is not very stable; it cannot be evaporated to dryness; its solution decomposes spontaneously, and the more rapidly the more it is diluted; acids precipitate from it hydrated protoxide with disengagement of oxygen, a part of which dissolves in the water, forming binoxide of hydrogen, hydrochloric acid is decomposed, and its chlorine set at liberty. Sulphurous acid is transformed into sulphuric acid, which combines with the protoxide of cobalt. By estimating the cobalt and determining the quantity of sulphuric acid formed in a given volume of cobaltate of potash, the author has ascertained the composition of cobaltic acid; he represented it in his first paper by CoO_5, and afterwards by CoO_3. It would be interesting to compare this compound with that obtained by M. Schwartzenberg by fusing oxide of cobalt with potash in contact with the air.[†]

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[*] *Journal für Praktische Chemie*, xc., 213.

[†] *Ann. de Chemie et de Physique*, l.

An Introduction to Chemical Philosophy, according to the Modern Theories, by ADOLPHE WURTZ, *F.R.S.*

PART I.

EQUIVALENTS, ATOMIC WEIGHTS AND MOLECULAR WEIGHTS.

SECTION II.—*New System of Atomic Weights.*

(Continued from page 135.)

1. The new atomic weights are identical, with about three exceptions, with those deduced from Dulong and Petit's law. It follows from M. Regnault's researches that the anomalies observed in this law (pointed out at p. 109) were owing to inaccurate determinations of the specific heat of many bodies. But, on the other hand, M. Regnault has found that this law does not yield results of that rigorous accuracy which it was at first supposed to do, as may be seen by the following table:—

Names of solid elements.		Specific heats.	Atomic weights.	Product of specific heat multiplied by atomic weight.
Sulphur (between 0° and 100°)		0·2026	32	6·483
Selenium		0·0762	79·5	6·058
Tellurium		0·0474	129·	6·115
Bromine (between −78° and −20°)		0·08432	80	6·746
Iodine (between 0° and 100°)		0·05412	127	6·873
Phosphorus (between 10° and 30°)		0·1887	31	5·850
Arsenic		0·08140	75	6·095
Carbon	graphite	0·200	12	2·400
	diamond	0·147	12	1·764
Crystallised boron		0·250	11	2·750
Silicium (mean)[*]		0·176	28	4·928
Potassium		0·1695	39·1	6·500
Sodium (between −34° and +7°)		0·2934	23	6·748
Lithium		0·9408	7	6·586
Thallium		0·03355	204	6·844
Magnesium		0·2499	24	5·998
Aluminium		0·2143	27	5·786
Manganese		0·1217	55	6·693
Iron		0·5138	56	6·115
Zinc		0·09555	65·2	6·230
Cadmium		0·05669	112	6·349
Cobalt		0·1068	59	6·301
Nickel		0·1089[†]	59	6·424
Tungsten		0·0334	184	6·146
Molybdenum		0·0722	96	6·931
Lead		0·0314	207	6·450
Bismuth		0·0308	210	6·468
Copper		0·09515	63·5	6·042
Antimony		0·05077	122	6·118
Tin		0·05623	118	6·635
Mercury (between −77°5 & −44°)		0·03247	200	6·494
Silver		0·05701	108	6·157
Gold		0·0324	197	6·383
Platinum		0·03293	197·5	6·487
Palladium		0·0593	106·5	6·315
Osmium		0·03063	199·2	6·101
Rhodium		0·05803	104·4	6·058
Iridium		0·03259	198	6·453

It is seen that the only exceptions to Dulong and Petit's law are carbon, silicium, and boron. This circumstance is doubtless due to some peculiarity in the molecular constitution of these bodies in the free state, and which is connected with the many allotropic states which they can assume. Let us take carbon as an instance. The different modifications of this element possess different specific heats, and consequently different thermal equivalents; and whilst in the case of other elements the thermal equivalents are identical with the atomic weights obtained by chemical means, this is not the case with carbon. It is also to be remarked that there exists no simple relation between the thermal equivalents of carbon and its atomic weight, 12. In the following table these thermal equivalents have been obtained by dividing the constant product 6·4[‡] by the specific heats:—

	Specific heats.	Thermal equivalents.	Atomic weight of carbon.
Animal charcoal	0·26085	24·5	
Graphite	0·200	32·0	12
Diamond	0·147	43·5	

Experience, moreover, has shown that carbon in combination possesses a different specific heat from that which it has in its different modifications. If, therefore, Dulong and Petit's law were rigorously exact, one ought to say that, as carbon possesses different specific heats according as it is free or combined, and according to its different allotropic states, so also does it possess different atomic weights, and these atomic weights are identical with the thermal equivalents given above. This conclusion appears strange at first sight. It is, however, strengthened by the interesting facts which Mr. Brodie[§] has discovered relative to the oxidation of graphite. In treating this body with nitric acid and chlorate of potash he obtained a certain acid, graphic acid, in which he proves the existence not of carbon, but of graphite itself. He represents the composition of this acid by the formula $Gr_4H_4O_5$, in which the graphite possesses the atomic weight 33, which approaches closely to the thermal equivalent 32 indicated above.

Thus, chemical facts and theoretical considerations respecting specific heat lead us to look upon free carbon as forming in its various states aggregations of matter differing from the chemical atom which exists in the combinations of this body. These aggregations which are governed by heat differ in relative weights according to the allotropic states of carbon. They represent the physical atoms of free carbon, and for graphite at least it would appear that these atoms are capable of forming special combinations.

Such is the interpretation which the facts at present known allow us to give to the anomalies which are presented by the specific heats of carbon. There is nothing to prevent the same interpretation being extended to boron and silicium, so similar to carbon by the number of their allotropic states.

As to the other elements, it is seen by the preceding table that the product of their specific heats by their atomic weights are practically equal, which is the same thing as saying that the specific heats of their atoms are sensibly identical. They are not absolutely the same, to judge by the results of experiment; but the differences which are shown in this respect may be due to certain disturbing causes.

In reference to this subject, it must, in the first place, be considered that the atomic weights of some elements are not determined with all the accuracy which is desirable, and the same, perhaps, may be said of the specific heats of some simple bodies which it is difficult to isolate in a state of perfect purity. On the other hand, as M. Regnault has observed,[||] the determination of the specific heats of solid bodies involves some uncertainty, "for it includes many other elements which have not

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[*] Regnault, *Annales de Chimie et de Physique*, 3rd series, lxiii. 24.

[†] Mean of M. Regnault's determinations, *Annales de Chimie et de Physique*, 3rd series, lxiii. 23.

[‡] Mean of the product of atomic weights by specific heats.

[§] *Philosophical Transactions*, 1859, p. 249.

[||] *Annales de Chimie et de Physique*, 3rd series, xxvi., 262.

yet been successfully separated, especially the latent heat of dilatation, and a portion of the latent heat of fusion which bodies successively absorb as they soften, frequently long before the temperature which is regarded as their fusing point."

Similar disturbing influences naturally interfere with the specific heat of compound bodies. It has been observed that in general equivalent quantities of substances which possess a similar atomic composition have also the same specific heat; the product of the specific heat of these substances by their atomic weights are sensibly equal; and if this product is called *atomic heat* we may say with Hermann Kopp "that these bodies possess the same atomic heat."[¶]

This latter physicist has, however, pointed out several exceptions to this law. Whether they be due to the above-named disturbing influences, or to some other cause, it is not less true that the law in question is worth attention, for it is verified in the case of many groups of analogous bodies, provided the new atomic weights are adopted for the elements. Thus the carbonates[**]

$$\mathrm{RCO_3 = RO,CO_2}$$

and the silicates—

$$\mathrm{RSiO_3 = RO,SiO_2}$$

have the same atomic heat provided the atomic weight 12 is taken for carbon, and 28 for silicium.

M. Regnault observed some time ago that the chlorides of tin, titanium, and silicium possessed sensibly the same atomic heat, provided the composition of chloride of silicium were expressed by the formula $\mathrm{SiCl_4}$, and the atomic weight of silicium were consequently taken at 28[††]. The following figures demonstrate this:

	Specific heat.	Molecular weight.	Product.
Chloride of tin . .	0·1413	260	36·7
Chloride of titanium .	0·1813	192	84·8
Chloride of silicium .	0·1907	170	32·4

It is thus that theoretical considerations respecting the specific heat of some compounds of carbon and silicium justify the atomic weights assigned to these elements, which, in the free state, form exceptions to Dulong and Petit's law.

Upon comparing the atomic heats of a large number of compound bodies, it is observed that they are formed of the sum of the atomic heats of their elements. Indeed, the product (CA) of the specific heat multiplied by the atomic (molecular) weight is practically equal to $n \times 6{\cdot}4$; n being the number of elementary atoms contained in a compound having the specific heat C, and the molecular weight A; and 6·4 being the mean atomic heat of simple bodies as derived from the table on page 134. We thus get the formula[‡‡] $n \times 6{\cdot}4 = \mathrm{CA}$.

In some cases this relation may serve for the indirect verification of an atomic weight. As an example:—Is the atomic weight of mercury 100 or 200?

In the former case if we represent 100 of mercury by the symbol Hg, the mercurous and mercuric chlorides, bromides, and iodides contain—

Mercurous compounds.	Mercuric compounds.
$\mathrm{Hg_2Cl}$	HgCl
$\mathrm{Hg_2Br}$	HgBr
$\mathrm{Hg_2I}$	HgI

In the latter case, if we represent 200 of mercury by the barred symbol Ħg,[§§] they become—

Mercurous compounds.	Mercuric compounds.
$\text{Ħ}\mathrm{g_2Cl_2}$ [‖‖]	$\text{Ħ}\mathrm{gCl_2}$
$\text{Ħ}\mathrm{g_2Br_2}$	$\text{Ħ}\mathrm{gBr_2}$
$\text{Ħ}\mathrm{g_2I_2}$	$\text{Ħ}\mathrm{gI_2}$

Judging from the specific heats of these compounds, it is the second of the formulæ which express the atomic composition of these chlorides; for in this case we have $n = 4$ for the mercurous compounds, and $n = 3$ for the mercuric compounds; and the atomic heats, which can be calculated according to the preceding formula, are practically the same as those directly deduced from experimental data.

		Molecular weights.	Product of molecular weight by specific heat.	Calculated atomic heats.
Formulæ.	Specific heats.	Ħg=200	Experimental atomic heats.	$n \times 6{\cdot}4$.
$\text{Ħ}\mathrm{g\,Cl_2}$.	0·0689	271	18·67	19·2
$\text{Ħ}\mathrm{g\,I_2}$.	0·0420	454	19·06	19·2
$\text{Ħ}\mathrm{g_2Cl_2}$.	0·05205	475	24·51	25·6
$\text{Ħ}\mathrm{g_2I_2}$.	0·0385	654	25·83	25·9

It must be mentioned that this very simple relation between the atomic heat of a compound and the atomic heats of the elements which it contains does not hold good, according to M. Hermann Kopp, for all compounds. It is accurate in the case of chlorides, bromides, and iodides. It has just been shown, for instance, that the iodine and the mercury possess, in the form of iodide of mercury, the same atomic heat which they have in the free state. But this is not always the case. The preceding rule, therefore, will not bear general application.

(To be continued.)

On the Separation of Manganese from Cobalt, Nickel, and Zinc, by WOLCOTT GIBBS, *M.D.*

SCHIEL's method of separating manganese from the alkaline earths by adding acetate of sodium to the mixed solutions, heating the liquid gently, and then passing chlorine through it, so as to convert the manganese into a hydrate of the sesquioxide, is better than that formerly given by myself, in which peroxide of lead is used as the oxidising agent. With respect to Schiel's method, however, it must be remarked that it cannot be employed to separate manganese from nickel or cobalt, because both of these metals are converted into higher oxides under the same circumstances. Nickel may, as Popp has recently shown, be completely precipitated as a deep blue hyperoxide; while, as I have myself observed, cobalt is also oxidised, though not precipitated, unless the solution is boiled with an alkaline carbonate. In separating manganese from zinc, calcium, or magnesium, I have repeatedly found that a second treatment is necessary in order to obtain a perfect separation. This second treatment may be neglected in separating manganese from calcium and magnesium, but not in separating it from zinc, although the addition of a few drops of free acetic acid renders the process more exact.

[¶] M. Regnault has put this law in the following manner:—"*The specific heats of compound bodies having the same chemical formulæ are to one another in the inverse ratio of their equivalents.*"—*Annales de Chimie et de Physique*, 3rd series, xxvi., 264.

[**] It is the same according to Hermann Kopp in the case of nitrates and chlorates $\mathrm{RN\Theta_3}$ and $\mathrm{RCl\Theta_3}$, perchlorates and permanganates $\mathrm{RCl\Theta_4}$ and $\mathrm{RMn\Theta_4}$, sulphates and chromates $\mathrm{RS\Theta_4}$ and $\mathrm{RCr\Theta_4}$.

[††] *Annales de Chimie et de Physique*, 3rd series, ix., 341.

[‡‡] Hermann Kopp, *Comptes Rendus*, lvi. 1254

[§§] The barred symbols represent atomic weights which are double the equivalents, as explained further on.

[‖‖] Or ĦgCl, ĦgBr, ĦgI. These are the latest formulæ adopted by M. Cannizzaro. We prefer the doubled formulæ, for reasons to be given hereafter. It is evident, besides, that if arguments based on the specific heat of the compound bodies in question are allowed to decide in reference to the atomic weight of mercury, they throw no light whatever on the question as to doubling or not the formulæ of mercurous compounds. If they are doubled, as we have written them, each side of the equation—

$$n \times 6{\cdot}4 = \mathrm{C,A}$$

must be multiplied by 2.

Though the method of separating manganese from other bases by means of peroxide of lead, which I formerly proposed, will hardly be used in future, now that we are in possession of more convenient processes, it will still be of some interest to chemists to know the precise nature of the insoluble black compound which is formed when peroxide of lead, PbO_2, is digested or boiled with an excess of a solution of chloride or nitrate of manganese and afterwards thoroughly washed. An analysis of this body, made some years since in my laboratory by my lamented friend and former pupil, Mr. Theodore Parkman, gave the following results:—

		Anhydrous.	Theory.
Manganese	35·10	37·96	37·53
Lead	32·49	35·13	35·26
Oxygen	24·87	26·90	27·20
Water	7·52	—	—
	100·00	100·00	100·00

Neglecting the water, which may have been, in part at least, mechanically combined, and which amounts to between three and four equivalents, we have the formula, $MnO_2 + 4PbO_2$, as the simplest expression of the result of analysis.

A simple and perfectly satisfactory process for separating manganese from cobalt, nickel, and zinc, is the following:—To the neutral or nearly neutral solution of the chlorides, acetate of sodium is to be added in excess together with a few drops of free acetic acid. The solution is then to be boiled, and a rapid current of sulphydric acid gas passed through it while boiling, and continued for half-an-hour. Every trace of cobalt, nickel, or zinc, is precipitated in the form of sulphide, while the whole of the manganese remains in solution. The precipitate is to be thrown on a ribbed filter and quickly washed with cold water saturated with sulphydric acid gas. It is easily washed, and though the sulphides of cobalt and nickel precipitated in this manner are far more easily oxidised than when precipitated by boiling sulphide of sodium from boiling solutions, they will be found to present no difficulty as regards oxidation upon the filter. Manganese may then be determined in the filtrate by boiling with chlorhydric acid and precipitating in the usual manner with carbonate of sodium. The mixed sulphides upon the filter—supposing for the sake of generality that all three are present—are to be dissolved in chlorhydric acid, and the metals converted into double cyanides by means of an excess of cyanide of potassium, after which the zinc may be precipitated by means of sulphide of sodium, as recommended by Wöhler.

When perfectly pure cyanide of potassium is not at hand, the following process will be found particularly convenient:—Acetate of sodium is to be added to the solution of the mixed chlorides, after which the vapour of cyanhydric acid, generated in a flask from sulphuric acid and ferrocyanide of potassium, is to be passed directly into the solution. Cyanide of zinc is immediately precipitated more or less completely as a perfectly white powder. A solution of sulphide of sodium is then to be added as long as a precipitate is formed, after which the sulphide of zinc is to be separated by filtration. Cobalt and nickel remain in solution as double cyanides. The same process may be used to separate manganese from cobalt and nickel, sulphide of sodium throwing down under these circumstances a pure flesh red precipitate. It is easy to see that zinc and manganese together may be separated from cobalt and nickel by the same process and at one operation. No cyanide of manganese appears to be formed when cyanhydric acid is passed into a solution containing a salt of manganese, acetic acid, and acetate of sodium.

I have stated in a former paper that the sulphides of nickel and cobalt are thrown down from boiling solutions by a boiling solution of sulphide of sodium in an insoluble form, so that in fact even strong chlorhydric acid scarcely exerts upon them an appreciable action. This process has been applied to the separation of cobalt and nickel from zinc and manganese by my excellent assistant, Mr. Maurice Perkins, and gives results which are very satisfactory, especially for qualitative purposes, the sulphides of manganese and zinc precipitated under the same circumstances being readily soluble, even in dilute acid. The process is now substituted in this laboratory for that given in most of the recent works on qualitative analysis, and has been repeatedly tested with satisfactory results.—*American Journal of Science and Art*, January, 1865.

On the Separation of Uranium from Zinc, Cobalt, and Nickel, by WOLCOTT GIBBS, *M.D.*

THE method which I have already given for the separation of manganese from cobalt, zinc, and nickel, by precipitating the sulphide of the three last-named metals, by means of sulphydric acid gas from a boiling solution of the acetates, may be also used, according to the carefully conducted experiments of Mr. Perkins for the separation of uranium from the same metals. The process is in all respects the same, and requires, therefore, no further description. It will be found much simpler and more convenient than that described by Rose, by means of carbonate of barium.—*Amer. Journ. of Science and Art*, January, 1865.

*On the Action of Caustic Soda on Ethylic and Methylic Alcohol,** *by Mr.* A. MYLIUS.

SCHUNCK'S experiments concerning the action on indigo blue of acetate of soda, caustic soda, and alcohol first led me to examine in his laboratory the influence of caustic soda on alcohol and methylic alcohol in sealed tubes.

I obtained in each case a resin, differing considerably from the resinous body which is obtained by boiling an alcoholic solution of caustic soda for some time at the ordinary pressure and then precipitating by an acid. This so-called aldehyde resin has a different composition according to the proportion of acid employed in its preparation, so that I think it not improbable that it may be composed of two resins. Its colour is dark brown, and it is soluble in alkali.

On heating the same solution for some time in sealed tubes, so as to obtain increased pressure, there is formed by the influence of the alkali a resin which is insoluble in alkali. In a short time the liquid becomes red, and on the addition of water the resin is precipitated, the liquid becoming colourless. This takes place also when methylic alcohol is employed.

The resins thus formed are of a red colour.

After filtration and washing with water the resin was dissolved in alcohol, and the residue, after evaporation, dried at 100° C. When cold these resins are hard and brittle, but they have no crystalline structure. They are soluble in alcohol and ether. The resin formed from methylic alcohol melts at 59° C., the other at 65° C. The odour of the former is like that of cedar wood, while that of the latter more resembles the smell of oranges. In general there is a great resemblance between these

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* Read before the Lit. and Phil. Society of Manchester.

resins and the natural resins, such as copal, &c. In employing methylic alcohol the formation of the resin takes place much more easily, and a greater quantity of product is obtained. I tried in various ways to decolorise the resins, but did not succeed.

Through the alkaline liquid filtered from the resin a current of carbonic acid was passed, then it was evaporated, and the saline residue having been treated with sulphuric acid in excess, the liquid was distilled. The distillate was acid; silver solution was reduced by it in an instant, so that there was little doubt of the presence of formic acid (but the peculiar smell of propionic acid could not be perceived).

From the analysis it must be inferred that the two resins have the same composition; but still, as their properties are not identical, I think they are only isomeric.

The analysis afforded the following results:—

1. 0·1860 grm. (methylic alc.) gave 0·5080 grm. carbonic acid and 0·1550 grm. water.

2. 0·2465 grm. (methylic alc.) gave 0·6795 grm. carbonic acid and 0·1965 grm. water.

3. 0·2090 grm. (ethylic alc.) gave 0·5745 grm. carbonic acid and 0·1590 grm. water.

4. 0·1805 grm. (ethylic alc.) gave 0·4960. grm. carbonic acid and 0·1330 grm. water.

These numbers lead to the following composition:—

	I.	II.	III.	IV.
C	74·50	75·10	74·97	74·95
H	8·90	8·85	8·95	8·26
O	16·60	16·05	16·08	16·79
	100·00	100·00	100·00	100·00

The formula $C_{12}H_8O_2$ with which they correspond requires in 100 parts

C	75·00
H	8·40
O	16·60
	100·00

The formation of the resins from the alcohols might perhaps be explained by assuming that aldehyde is formed by the oxidation of alcohol, and then by simple loss of water the aldehyde would be converted into resin, since—

$$3(C_4H_4O_2) - 4HO = C_{12}H_8O_2.$$

But the formic acid in this case would not stand in any relation to the resin, and even the formation of the resin from methylic alcohol could not easily be explained.

If we adopt the formula $C_{24}H_{18}O_4$, which requires 74·28 per cent. carbon and 9·10 per cent. hydrogen, we must assume that carbonic and formic acid are taken up by the alcohol, though it is very doubtful whether these acids could separate from a strong base like soda in order to form a neutral resin. The following equations will show what may be imagined to take place in this case:—

$$5(C_4H_6O_2) + C_2O_4 + C_2H_2O_4 = C_{24}H_{18}O_4 + 14HO.$$
$$10(C_2H_4O_2) + C_2O_4 + C_2H_2O_4 = C_{24}H_{18}O_4 + 24HO.$$

Taking two atoms of water from $C_{12}H_8O_2$, the formula of benzole $C_{12}H_6$, remains. I tried to form this carbohydrogen by distilling the resin; the distillate had a strong smell of carbolic acid; I acted on it with nitric acid; oxidation took place immediately after the addition of the acid. I now added water, which gave a yellow deposit. I dissolved the latter in alcohol, but on evaporating the alcohol I obtained a resin of the same appearance as the original one. Nitrobenzole had not been formed.

The two resins are of a constant composition, which is proved by the accordance between the third and the fourth analyses, which were made with specimens prepared at different times.

In order to ascertain whether formic or acetic acid takes part in the formation of the resins, I made two other experiments. In one case I added acetate of soda to the caustic soda and alcohol, and in the second case formiate of soda. I analysed the products, and arrived at the following results:—

I. 0·2050 grm. (acetate of soda) gave 0·6190 grm. carbonic acid and 0·1625 grm. water.

II. 0·2255 grm. (acetate of soda) gave 0·6800 grm. carbonic acid and 0·1745 grm. water.

These numbers lead to the following composition:—

	I.	II.
C	82·37	82·24
H	8·80	8·58
O	8·83	9·18
	100·00	100·00

The formula $C_{28}H_{18}O_2$ requires

C	82·90
H	8·91
O	8·19
	100·00

Assuming that acetic acid is necessary for the formation of this resin, which differs from the products obtained without the addition of the acetate, the following equation will show the way in which the resin has been formed:—

$$4(C_4H_6O_2) + 3(C_4H_4O_4) = C_{28}H_{18}O_2 + 18HO.$$

In employing formiate of soda I obtained a resin of the same composition as that produced when no formiate was present.

0·2100 grm. gave 0·5795 grm. carbonic acid and 0·1610 grm. water = 75·25 per cent. carbon and 8.57 per cent hydrogen.

The investigation has therefore led to the discovery of the following facts:—

(1.) The resins which are obtained by the action of caustic soda on ethylic and methylic alcohol in sealed tubes differ from the resin that is formed by the same substances at the ordinary pressure in open vessels.

(2.) Methylic and ethylic alcohol produce resins of the same composition.

(3.) Formic acid is formed.

(4.) When acetate of soda is added the resulting resin differs in its composition.

*The Preparation of Litmus,** by M. DE LUYNES.

Two different products are included under the name of litmus, that in sheets and that in cakes. The latter is used as a reagent; with water or alcohol it gives a violet-blue liquid, which becomes light red by contact with acids.

The process for preparing litmus consists in colouring orchil lichens under the influence of air and ammonia, in the presence of a large excess of alkaline carbonate. M. Gelis has tested the exactness of these indications, and has obtained very excellent litmus by treating orchil lichens, mixed with half their weight of carbonate of potash, by ammonia. But whatever the mode of preparation, either carbonate or sulphate of lime is added to the litmus paste, to dry and preserve the colouring

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* *Journal de Pharmacie et de Chimie.*

matter, which constitutes but a very small fraction of the total weight of the cakes.

M. Dumas has shown that when orcine becomes coloured under the influence of air and ammonia, it produces only one colouring matter, which is orceine. By modifying the circumstances under which orcine becomes coloured, M. de Luynes has succeeded in preparing a product identical in its properties with litmus. As litmus has not yet been obtained by means of orcine, and as some chemists seem to doubt whether it can be so derived, M. de Luynes has adopted the following process:—He mixed orcine with twenty-five times its weight of crystallised carbonate of soda, and five times its weight of water, with the addition of a weight of liquid ammonia, not more than equal that of the orcine, in imperfectly stopped mattrasses. He heated the whole to between 60° and 80° for four or five hours, taking care to stir it from time to time. The dark violet-blue liquid he diluted with water and saturated with a slight excess of hydrochloric acid, which precipitated the colouring matter; this latter washed and dried is pure litmus.

Litmus thus prepared is in the form of small irregular masses with the variegated metallic reflections common to most colouring matters. It is very slightly soluble in cold water, to which it imparts a wine-coloured tinge, which by contact with acid turns to the colour of onion skin, and with alkalies to violet blue. In alcohol also, which it colours yellow. Concentrated sulphuric acid dissolves it, taking a very rich violet-blue colour, which becomes light red on the addition of a large quantity of water.

The alcoholic solution, diluted with water, constitutes a reagent extremely sensitive to the slightest trace of alkaline substance. By adding a little potash to it, a blue liquid is obtained, which in contact with acids, sulphuretted hydrogen, and other compounds behaves in the same way as ordinary litmus solution.

Dry litmus, heated in a tube, gives an abundant deposit of carbon, and disengages ammonia.

The preparation of ordinary litmus solution requires some time; it does not keep long without altering, and to render it sensitive the excess of alkali it contains must be saturated. M. de Luynes' product keeps without altering in the dry state; the cold solution can be very rapidly prepared, and may be immediately employed in any determinations by standard solutions.

TECHNICAL CHEMISTRY.

*Preparation of Sulphate of Ammonia.**

MM. Margueritte, Lalouet, de Sourdeval, and Worms, of Romilly, have, with the co-operation of the able director of the Compagnie Richer, established at Bondy a large factory of sulphate of ammonia, producing daily from 7000 to 8000 kilogs. The raw material is the liquor of the Bondy basins, which is merely the liquor of cesspools left to stand for a time sufficient to exhaust the fermentation, and transform the urea into carbonate of ammonia, the solution of which is decanted. Ammonia exists in these liquids in the state of sesquicarbonate or bicarbonate.

The distilled ammoniacal liquid, which is perfectly limpid, marks 18° on Baume's areometer, and even more than that, for the solid carbonate may be obtained.

Ammoniacal sulphate and hydrochlorate are prepared by the direct action of the ammoniacal liquid on sulphuric acid at 55°, or hydrochloric acid at 22°. The evaporated salts are sublimed in the ordinary manner on hearths heated by the waste heat.

The manufacture of ammoniacal salts will before long absorb all the liquids daily carried to Bondy; and if, as is to be hoped, some means is found to accelerate the production of powdered night-soil, the manufactory of Bondy, which is very favourably situated, will become no greater nuisance than others of its kind.

M. Margueritte is now engaged on a new improvement in the manufacture of sulphate of ammonia, in which he substitutes gypsum for sulphuric acid.

Carbonate of ammonia, by double decomposition, produces carbonate of lime and sulphate of ammonia. This reaction is well known, but what is new is that this reaction is singularly facilitated by the addition of a small quantity of chloride of calcium.

PHARMACY, TOXICOLOGY, &c.

New Process for Making Fluid Extracts, by Mr. Spencer Thomas.

This invention relates to an improved process for producing that class of extracts which are made so that a certain amount of liquid shall represent, pound by pound, medically the same quantity of crude drug, and which are generally obtained by extracting with a large excess of liquid and evaporating down to the desired strength. The disadvantages of the old process are well known to every chemist. The menstrua used for making extracts are usually of an etherial or volatile nature—such as alcohol of various strength—and their strength changes by evaporation as they are exposed for a longer or shorter period to the open atmosphere. If such menstruum is poured over a certain drug, it dissolves and extracts more or less of the soluble parts of the same according to its strength; but if the same liquid has to be poured repeatedly over the same drug, it loses its strength alcoholically, and some of those portions first dissolved are precipitated, and an imperfect extract is the result. The value of the extract being determined by its alcoholic strength when finished, the same or similar reasons render it objectionable to subject the extract, when first obtained, to the evaporating process; for by this process the volatile or spirituous parts of the menstruum are first evaporated, and the weaker liquid is not capable to keep in solution many of those parts of the drug which originally had been dissolved in the extract.

These objections are obviated by my process, which is carried out in the following manner:—I first weigh off a quantity of drug, and the same quantity, or more by weight, of the menstruum or liquid by means of which the extract is to be made. A little more of the menstruum being required, as a little moisture is left in at last pressing. The drug being ground to proper fineness, is then dampened with a small portion of the liquid, and subjected to heavy pressure (say from 800 to 1000 tons), whereby all the liquid, or nearly so, together with such parts of the drug which have dissolved in the same, is expressed. A fresh portion of the liquid is then sprinkled over the drug; a little time being allowed for the liquid to dissolve the soluble parts of the drug, and the same process of pressing repeated until the whole quantity of liquid is used up and the drug is completely exhausted, and the required measure obtained. By this process, an extract is obtained which

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* *Bulletin de la Société Chimique.*

represents, pound by pound, the crude drug. The drug is perfectly extracted, and the menstruum preserves its original strength throughout, so that the same is capable to retain in solution all those parts which are dissolved during the various stages of the process. Furthermore, by my process, the tedious and expensive process of evaporation is dispensed with, and concentrated fluid extracts of any description can be produced cheaper and better than by any process heretofore applied; and as the application of heat is entirely avoided, the preparation does not receive the injury by heat that all such preparations are liable to, if heat is applied to them, no matter how carefully applied or moderate the degree of temperature; and furthermore, the change thereby of strength of solvent is avoided.—*United States' Patent.*

PHYSICAL SCIENCE.

On the Rate at which Different Liquids Flow through Syphons, by John Galletly.

In a note of Dr. Ure's, curiously gathered, I believe, by Professor Hunt into his Dictionary of Arts, &c., I have seen it stated that Dr. Ure had tried the rate at which water, sulphuric acid, and rape oil flowed from a platinum vessel through a small platinum syphon. He found these fluids to run off at very different rates, but his exact numbers I cannot at present lay my hands on. The obvious difference in viscosity of the liquids employed seems to have generally been considered sufficient to account for his results. I have found, however, such differences between liquids apparently of about the same degree of limpidity as to lead me to the belief that this method of examining an important property of these fluids is worthy of attention.

As an illustration, I may give the periods required to draw off the liquids named in the following table by a syphon of somewhat narrow quill tubing from a phial holding a little more than 4 oz.; the position of syphon and temperature (60°F.) being the same in all cases:—

Water	74 seconds
Ether	48 "
Bisulph. carbon.	47 "
Whisky, 914 sp. gr.	182 "

Here it will be seen that the differences are somewhat remarkable, and although this was rather a narrow syphon the following results will show that the variations can be as great by employing the tubing in common laboratory use for drawing off the liquids over precipitates, &c. Poiseuille, by employing capillary tubes and somewhat elaborate apparatus, has obtained similar results, and of greater scientific accuracy, of course. Professor Graham has likewise employed capillary tubes in his valuable experiments "On Liquid Transpiration," but the much greater ease with which one can compare the flow of separate liquids by means of a common bottle and syphon may not be without its use, and especially as a guide to interesting results in more elaborate investigations.

The narrower the syphon the greater difference is always found between the rate of efflux of various liquids. I will not give any illustration of this statement, as numerous experiments uniformly confirmed it. The same is the case when the long limb of the syphon approaches the level of the short one. As an indication of the differences to be obtained by more nearly equalising the syphon limbs, I will quote the following experiments:—

The bottle employed held 7300 grs. water, was about 4½ inches deep, syphon a little over ¼th inch bore nearly uniform throughout. In experiments in 1st column long limb 18½ inches longer than short limb. 2nd column 9⅛ inches was cut off long limb. 3rd column 9⅛ inches more cut off long limb, leaving it only ¼ inch below level of short limb. Temperature in all cases 60°F. On repeating the same experiment twice seldom more than one second difference was obtained.

	Sp. gravity.	First experiment. Seconds.	Second experiment. Seconds.	Thir experiment. Seconds.
Water	1000	49	60	212
Paraffine oil	826	79	—	516
Boghead naphtha	765	49	59	221
Turpentine	876	57	79	334
Whisky	914	85	120	515
Petroleum	812	83	—	549
Turpentine & naphtha half of each	825	48	64	249

It is curious to observe in the above table that although naphtha runs through the first syphon in a considerably shorter time than turpentine, that a mixture of these liquids in equal proportions flows at a slower rate than even the naphtha by itself. This is not observed as the syphon limbs get more nearly equal. The cause is evidently the greater weight of liquid in the long limb drawing it faster over without the viscosity being increased proportionately.

Experiments were made with wide and narrow syphons adjusted to empty a bottle of water in the same time, to see whether other liquids would also flow through them in an equal time, but the numbers obtained were widely different.

I tried also the effect of using a long and short syphon keeping the ends of the limbs at the same comparative level in both cases. First both limbs were about 19¼ inches long, the long limb being kept ⅜ths inch below the level of the other. In the second experiment 10¼ inches was cut equally off both limbs. This syphon was almost uniform in bore, and 19 inches in diameter. The same bottle was employed as in former experiments, holding 7300 grs. water.

	First experiment. Seconds.	Second experiment. Seconds.
Water	179	119
Boghead naphtha	146	103
Turpentine	278	160

The value of this method of examining the flow of liquids, even in this rough way, may be illustrated by the following example. Bottle holding 7300 grs. water, syphon same as in third experiments of second table:—

	Specific gravity.	Seconds.
Paraffine oil	797	286
Petroleum	797	375

These experiments I did not mean for publication, but only as preliminary to a larger and more accurate series I intended making with tubes of as exactly uniform bore as could be obtained and on a considerable variety of liquids, but I must give up the subject, at least for the present, on account of my distance from a situation where these can be conveniently obtained.

Mandal, Norway.

Royal Institution.—The following are the arrangements for the ensuing week:—Monday, April 3, at 2 o'clock, General Monthly Meeting. Tuesday and Thursday, April 4 and 6, at 4 o'clock, Charles Newton, Esq., "On Recent Acquisitions to the British Museum." Friday, April 7, at 8 o'clock, Dr. A. W. Hofmann, "On the Atomic Theory." Saturday, April 8, at 3 o'clock, Prof. Marshall, "On the Nervous System."

PROCEEDINGS OF SOCIETIES.

ACADEMY OF SCIENCES.

March 20, 1865.

A NOTE by M. Meunier "*On the Solution of some Metallic Oxides in Caustic Alkalies in a State of Fusion*" gives an account of some new metallic combinations. Binoxide of mercury dropped into fused potash is quickly dissolved, giving a colourless liquid if the materials are pure, and evolving no gas. How much of the oxide will dissolve the author has not determined; but when the amount of it becomes considerable the temperature rises and oxygen is given off. At the same time the liquid becomes yellow, and acquires an oily consistence. The solution as it cools becomes suddenly coloured, and in the end takes a tint which is regulated by circumstances. Washing with cold water leaves a powder of the same colour as the mass, and the composition of which varies with the colour. A constant product can be obtained by throwing the mercuric oxide on potash not completely fused, stopping the heat as soon as the last portions of oxide disappear, and cooling very gradually. A violet-brown mass is thus formed, to which only sufficient water to dissolve the excess potash must be added; and thus we obtain a violet powder mixed with a greenish powder much lighter, and consequently the two can be separated by simple decantation. The violet powder under the microscope is seen to be made up of fawn-coloured crystals; the green powder is amorphous. Prolonged washing with water decomposes the violet powder, which must therefore be washed with alcohol; and it is better to allow the potash to deliquesce and wash it out with alcohol. The composition of these two combinations of mercuric oxide and potash the author has not yet determined. In a similar way soda yields an orange-brown crystalline powder. Protoxide of bismuth and oxide of cadmium also dissolve in the fused alkalies; but the author does not seem to have determined the exact nature of any of the compounds formed.

In a note "*On the Cementation of Iron by Cast-iron Heated Below its Fusing-point,*" M. Cailletet points out a new and perhaps useful method of making steel. By prolonged heating below its fusing-point cast-iron loses carbon; blades of iron, therefore, heated among clean borings of cast-iron become cemented and form excellent steel, according to the author, who has proved that blades in the same furnace, but not in contact with the cast-iron, are not cemented. The cast-iron loses none of its value in this operation, and the process is therefore cheap and practical.

M. Naguet gave an account of "*a New Aromatic Acid.*" Cymene $\Theta_{10}H_{14}$ is the highest of the hydrocarbides which until now has furnished an aromatic acid. The author has, however, succeeded in obtaining one from thymol, which contains $\Theta_{11}H_{14}\Theta_{31}$ thymicylic acid. He heated thymol with sodium, and at the same time passed a current of dry carbonic acid, imitating Kolbe's method of obtaining salicylic acid from phenol. The reaction is explained by the equation—

$$2\Theta\Theta_2 + \Theta_{10}H_{14}\Theta + \left.\begin{matrix}Na\\Na\end{matrix}\right\} = \left.\begin{matrix}H\\H\end{matrix}\right\} + 2C_{11}H_{13}Na\Theta_3.$$

Oil of thyme may be employed in place of thymol with the same result. The new acid may be separated by supersaturating the mass with acetic acid, then adding a slight excess of carbonate of ammonia, and separating the aqueous solution from the unattacked thymol. The aqueous solution is then concentrated and acetic acid again added, whereupon the new acid separates, and may be isolated by shaking with ether, in which it is freely soluble. The etherial solution by spontaneous evaporation yields the acid tolerably pure. Solution in boiling water and one or two recrystallisations from alcohol furnish it quite pure. The author describes the thymicylates of ammonia, silver, zinc, lead, lime, and baryta. The metals replace but one atom of hydrogen, but the author is still in doubt as to what class the acid belongs.

MM. Harnitz-Harnitzky and Menschutkin presented a note "*On the Compounds of Glycerine with Aldehydes.*" With monatomic alcohols aldehydes form *acetals*. Glycols also form combinations with aldehydes. The authors now complete the group by describing compounds of a triatomic alcohol, glycerine, with aldehydes, for which they propose the name *glycerals*. They have, in fact, formed glycerals with acetic, valeric, and benzoic aldehydes. The general method is to heat the two bodies for a long time in a sealed tube.

NOTICES OF BOOKS.

Report on the Air of Mines and Confined Places. By ANGUS SMITH, Ph.D., F.R.S. Part of the Appendix to the Report of the Royal Mines Commission. 1864.

[THIRD NOTICE.]

HAVING seen the diminution in the proportion of oxygen, and the increase of that of carbonic acid, in the air of mines, let us now proceed to notice the special causes of this deterioration, and also the presence of some abnormal ingredients. There are several sources of contamination. In the first place, there is the unavoidable deterioration which the air of a close end suffers from the respiration of the miner himself; there is also the further effects of the combustion of the candles; and, lastly, in the Cornish mines, with which we are now concerned, another source of contamination, namely, the combustion of the gunpowder used in blasting, which, while furnishing noxious gases to the atmosphere, also loads it with solid impurities.

Estimating the cubic capacity of a close end, in which two miners work, at 1200 cubic feet, Dr. Smith calculates that the respiration of two men working for eight hours will introduce into the atmosphere 10·4 cubic feet of carbonic acid, constituting 0·86 of the 1200 feet of air. The combustion of half a pound of candles during the same period will further yield 12·044 cubic feet of carbonic acid, adding 1·02 per cent. to 1200 feet, in which we shall now have 1·883 per cent. of carbonic acid. In the same space three charges of gunpowder of four ounces each will be fired, by which the amount of carbonic acid will be further increased 0·233 per cent., giving us altogether 2·116 per cent. in the atmosphere of the close end. Besides the carbonic acid, we have now other objectionable ingredients, solid as well as gaseous, in the air.

The combustion of gunpowder yields a variety of products, varying somewhat, according to circumstances. Dr. Smith remarks that the theoretical results which should ensue from the combustion are probably never actually accomplished, no mixture of the ingredients being sufficiently intimate to produce them. "The carbon is not wholly burnt during the explosion, the sulphur is not wholly as sulphide of kalium, and the nitre is not wholly robbed of its oxygen." The whole of the gunpowder, in fact, is not exploded when fired as in blasting and under similar conditions, and, therefore, such calculations as these of the results of the explosion must always be more or less incorrect. They are, nevertheless, of great interest, not only to miners, but to military engineers and others. It has been said that in some of our casemated fortifications, and in one of our iron ships the gunners must inevitably be suffocated, in consequence of the vitiation of a close atmosphere by the combustion products of gunpowder.

Dr. Smith's calculation of the composition of 1200 cubic feet of air in which twelve ounces of powder have been fired and two men have breathed will give us some remote idea of the composition of the air between decks in a ship in action, or that of a casemate. We give in the following table the ingredients by weight thrown into the whole 1200 feet and in one foot :—

	Grains in 1200 c. ft.	Grains in 1 c. ft.
Oxygen	139737·7945	114·802599
Nitrogen	520470·4	433·818200
Carbonic Acid . . .	18525·2	16·008600
Carbonic Oxide . . .	49·2	0·041015
Hydrogen	1·1088	0·000911
Sulphide of Hydrogen .	9·239	0·00769
Sulphate of Potash . .	2233·936	1·862865
Carbonate of Potash . .	668·375	0·557316
Hyposulphite of Potash .	172·668	0·144
Sulphide of Potassium .	112·592	0·093897
Sulphocyanide of Potassium	16·186	0·013476
Nitrate of Potash . .	196·773	0·164075
Carbon	38·482	0·032089
Sulphur	7·191	0·005989
Sesquicarbonate of Ammonia	151·079	0·125779
Solids alone		2·999486

But this table does not give the whole of the ingredients of the air in a close end. There is still organic matter, and fine particles of the rock and ore driven about as dust, together with sulphurous acid and arsenic. As regards the last, Dr. Smith observes :—"The pyrites of Cornwall contain a large amount of arsenic, and when struck with a hammer or pick the smell is very strong. It is not a smell which a chemist only may trace, but one well known, and used by the men as a test of the materials. This is a circumstance which may signify good or evil to the miners, most probably evil, but it cannot be entirely avoided, and is counteracted only by draughts of air." "To this long list of impurities," he continues, "must now be added the products of the distillation of tar and of canvass from the burning fuses. These are in amount sufficient to affect the senses, and are of themselves extremely complex."

The table we have given above will have prepared our readers for the remark "that the air issuing from a mine is not an invisible fluid, but contains solid material enough to make it distinctly perceived, if not in all cases, still in cases of mines considered to be well ventilated." Nor will any one be surprised to read that a careful microscopic examination of the tubes in which Dr. Smith collected the air showed that the floating crystallised bodies of the mine air had deposited on the glass. Among the crystals, those of nitrate and sulphate of potash could be most readily distinguished. But, besides the crystalline bodies, there are substances transparent but shapeless, some looking like pieces of quartz, some perhaps looking more like glass. There are also opaque substances which constitute the dust of the rocks, and sometimes portions blacker than others, charcoal of the gunpowder, or perhaps unburnt gunpowder. "Again, there are occasionally filaments of evident organic origin among the complicated material called dust. Portions of ourselves are to be found in it, no doubt; and portions probably of everything existing around us."

And now, how much of this is it to be supposed that a miner inhales in the course of his day's work? Dr. Smith calculates that a man takes into his lungs in the time 111 cubic feet of air, and, allowing for the variations of the atmosphere between the explosions, he supposes that these 111 feet will contain the full amount of solid matter in 30 feet immediately after an explosion. These 30 feet, then, will contain 89·98450 grains of solid matter, and this amount we may suppose a man to inhale with the 111 cubic feet of air. It is impossible to imagine that this cannot be detrimental to a miner's health.

We come next to the organic matter in the air, the consideration of which we postpone until next week.

The Gas Works of London. By Zerah Colburn, C.E. London: E. and F. N. Spon. 1865.

A history of coal gas, and a description of one of our metropolitan works, would make a most interesting book. To trace the manufacture from its birth in Mr. Murdock's house at Redruth, and its infancy in Mr. Winsor's experiments at the Lyceum Theatre, and the lighting of one side of Pall Mall, to its present gigantic development as represented at the Pancras Station of the Imperial Company, and by the hundreds of miles of mains which now deliver gas over the metropolitan district; and to show the influence of this one manufacture on our moral and social life and commercial progress, would be work which might engage the pen of one who should be at once a chemist, an engineer, and a philosopher—a work in which the future historian of the last half century must find important materials and suggestions. In the absence of such a book Mr. Colburn comes before us in the character of an engineer only, to give us a few dry facts, and (as we shall presently show) a few fictions concerning the manufacture of gas in London to-day. It is only fair to say that he does not pretend to be anything more than an engineer, and therefore the less blame attaches to him for the omissions he leaves and the mistakes into which he falls.

Of the extent of the manufacture of gas in London few persons have any adequate idea. It is estimated, the author informs us, that 1,000,000 tons of coal are carbonised annually, the value of the gas and residual products amounting to 2,000,000*l*., which is equal to 14*s*. 6*d*. for every man, woman, and child in the metropolis. The labour in the nineteen gas works employs in the winter between 4000 and 5000 men.

Concerning the process of gas-making, and the arrangements for carrying it out, we need say nothing, since every reader of the Chemical News must be more or less intimately acquainted with them. A chemist's business in the matter begins specially with the purification. The illuminating gases leave the hydraulic main contaminated with various gases and vapours, prejudicial in themselves, or generating noxious matters in their combustion. The most obnoxious of these are sulphuretted hydrogen and ammonia and the vapour of bisulphide of carbon. Ammonia is removed by passing the gas through what are called scrubbers,—towers filled with coke or broken crockery, over which trickles a stream of water or dilute acid. The acid employed is usually sulphuric, and the evaporated solution then yields the sulphate of ammonia for the manure and the alum manufacturers. In some instances hydrochloric acid is employed, and what Mr. Colburn calls chloro-hydride of ammonia, or chlorohydride of ammonium, is formed, the uses of which are known to all our readers. In other cases ammonia is distilled from the aqueous solution, and passed into sulphuric acid, by which means a tolerably pure sulphate is obtained in one operation. This utilisation of ammonia has brought much additional profit to the gas-makers, who, not many years ago, sold it for a mere trifle, or paid to have the liquor removed, as some country makers do still. A very important use, however, to which we shall presently allude, has recently been found for it in the gas-works.

The sulphur compounds, are almost profitless, and form also the most objectionable ingredients in gas. Of sulphuretted hydrogen there is but little to complain, since it is almost completely removed in the purification by oxide of iron. The means employed for the removal of bisulphide of carbon are as yet very inefficient. No process hitherto devised is at once practical and thoroughly effective. Mr. Bowditch's method—one of the best yet invented—is open to the objection that the gas is so much heated and expanded that it necessitates additional contrivances for bringing the gas down to the ordinary temperature again. The same objection will apply to Mr. Lewis Thompson's method, which we recently noticed. Dr. Angus Smith's process, which consists in passing gas through layers of sawdust, saturated with what we may call plumbate of soda, is unfortunately but partially successful.

Recent experiments, however, have shown how one impurity in gas may be employed to remove another. It has been found that simply washing the gas with strong ammoniacal liquor suffices to take out the great bulk of the bisulphide of carbon. This washing is effected as soon as the gas has passed through the condensers. It is then carried into a kind of tower, in its progress up which it encounters a tremendous shower of the ammoniacal liquor. To be very effective, a relatively enormous proportion of the liquor is required—as much as a gallon to a cubic foot of gas has been employed; and with this it has been found that gas which entered the tower with 14 grains of sulphur to 100 cubic feet, left it only with 7 grains. What chemical changes take place in this mode of purification is not yet accurately known; but it seems probable that both the ammonia and the bisulphide undergo some decomposition, which results in the formation of hydrosulphocyanate and hydrosulpho-carbonate of ammonia. This method of purification, however, is still under experiment, and we hope to be able to supply further details.

Mr. Colburn, like every engineer, makes light of the bisulphide of carbon, and strangely enough prints almost *in extenso* the report of Mr. Versmann, which we reviewed (vol. iv., pp. 24—38) at the time of its publication. We need not go into that matter again; it will suffice to mention that, whereas Mr. Versmann found a little over *six* grains of sulphur in 100 cubic feet of gas in the experiments he made at the works of the Commercial Company, we found over *sixty* grains in the gas the same Company supplied to their customers. Since the date of those experiments (1861) the quality of London gas has certainly improved in this respect; but the companies in general keep pretty near the Parliamentary maximum of 20 grains in the 100 feet. Mr. Colburn had many means of finding out this fact. He might have read it in the newspapers which usually print every week abstracts of Dr. Letheby's reports to the Commissioners of Sewers. As, however, our author has neglected these sources of information, we will supply him with a few facts from the report for 1864:—

"In the course of the year," says Dr. Letheby, "840 examinations have been made of the gas for sulphur—that is, 280 examinations for each company (Great Central, City, and Chartered); and the range has been from 14·4 grains per 100 cubic feet to 35 grains. The average amount in the City gas has been 19·4, and in the Chartered 20·1, and in the Great Central 21·9; and of the 280 examinations of each company, the City gas has on 93 occasions contained more sulphur than is sanctioned by Parliament (20 grains per 100 feet) the Chartered on 139 occasions, and the Great Central 226 occasions." We leave this extract for Mr. Colburn's consideration on publishing a second edition of his book. For the rest we may say that, although the author had an opportunity of producing a book which would have much interest for either engineers, chemists, or the general public, according as the subject was treated, he has brought out one which possesses but little interest for either class of readers.

Journal für Praktische Chemie. No. 1, 1865.

The first article is "*A Contribution to our Knowledge of Indium,*" by C. Winkler. Reich and Richter, the discoverers of indium, have sufficiently described the chemical properties of the new metal; but it is satisfactory to find another chemist engaged in the same research. Winkler sought the metal in Freiburg zinc, which, besides indium, contains a small amount of lead, iron, arsenic, and cadmium, the proportion of indium being only 0·0448 per cent. The oxide of indium can be completely precipitated from an acid solution of the zinc by means of ammonia, but the amount of ammonia required to obtain a very small amount of the oxide is necessarily large. The author therefore points out some other cheaper methods. To these we shall return, and only stop here to point out the general properties of the metal and its salts. Indium is a lustrous metal, resembling platinum in appearance. It is malleable, and may be cut with a knife. It is not easily oxidised in the air. It dissolves in diluted hydrochloric and sulphuric acids with the evolution of hydrogen; when heated with strong sulphuric acid, sulphurous vapours are evolved; nitric acid quickly oxidises it. Heated in a crucible to a bright red heat, it is volatilised, and burns with a violet-blue flame to oxide, which appears as a yellow deposit on the sides of the crucible.

The specific gravity of the metal at 15° C. is 7·362. There appears to be only one oxide, InO, which is of a straw-yellow colour. The oxide dissolves in acids, forming colourless salts. The author then proceeds to describe various salts and their properties. He also sought to determine the atomic weight, but the results obtained by reducing the oxide in a stream of oxygen are very discordant; those obtained, however, by converting the nitrate into oxide agree much better. Three determinations gave respectively, 35·874, 35·927, and 35·953; the mean, therefore, will be 35·918, which may be taken provisionally as the atomic weight of indium. As everything relating to a new metal is of importance, we shall return to this paper.

The next paper is a continuation of Dr. W. Gibb's researches on the platinum metals, which we have already printed at length.

A short article "*On Fluochromate of Potash*" shows that powdered bichromate of potash dissolved in fluoric acid yielded ruby-red transparent crystals of a salt having the formula KCr_2FO_6, exactly corresponding to the chlorochromate of potash, with which, however, it is not isomorphous.

Another short paper "*On some Sulphocyanide of Gold Compounds*" describes double sulphocyanides of gold and potassium and gold and silver.

The next is an article by Stolba, "*On the use of Fluosilicic Acid in the Analysis of Potash and Soda Salts, and in the Separation of the Alkalies.*" The author gives volumetric processes, a description of which is not easily condensed, so we shall present them in a longer abstract than we can give here.

Short notices of parathionic, mono-sulpholactic, and mono-sulphomalic acids follow, and a longer article by Michaelson, "*On the Preparation of the Oxidation Products of Butylalcohol.*" It will be sufficient to give the titles of these papers.

Journal de Pharmacie et de Chimie. March, 1865.

The Parisian pharmaceutical journal is always for the most part made up of articles from the *Comptes Rendus* of the Academy, which will be found in our weekly notices. In this number, however, we have a paper "*On the Action of Chromic and Nitric Acids on the Vegetable Oils,*" which gives some facts respecting olive oil which may be useful to our readers, now that this oil is so often adulterated with cotton seed oil. We shall, therefore, reproduce the article at considerable length. The only other article noticeable is "*On the Detection and Estimation of Arsenic in Subnitrate of Bismuth,*" which, although it contains nothing new, may be of use to some of our pharmaceutical readers.

Royal Institution.—This evening, Friday, March 31, James Glaisher, Esq., F.R.S., "On Aërial Researches."

Royal Mint.—We are glad to learn that Dr. Stenhouse, F.R.S., has been appointed by the Master of the Mint non-resident assayer to the Royal Mint, in the place of Dr. Hofmann resigned.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

3048. C. A. Martins, Warrington, Lancashire, "Improvements in the application of photography to the ceramic arts or to glass."—A communication from J. B. Obernetter, Munich.—Petition recorded Dec. 6, 1864.

500. J. Nicholas, Aspull, near Wigan, Lancashire, "Improvements in the process and apparatus for producing oil and coke from coal and slack."—Feb. 22, 1865.

Notices to Proceed.

2748. A. Estourneaux and L. Beauchamps, Denain, France, "Certain improvements in non-conducting composition for preventing the radiation or transmission of heat or cold."—Nov. 7, 1864.

2801. W. L. Lees, Aston, Warwickshire, "A new or improved composition or cement for uniting or joining substances together, and for other purposes."—Nov. 11, 1864.

2821. F. A. Papps, Bow, "Improvements in malt liquors as tonics."—Nov. 12, 1864.

2832. G. E. Noone, Hastings, "Improvements in machinery for deodorising and utilising the sewage of towns, and in the treatment of other refuse to be combined therewith, both liquid and solid, for manure and chemical use."—Nov. 14, 1864.

2856. S. C. Kreeft, Fenchurch Street, London, "Improvements in the manufacture of iron and steel."—A communication from J. Bozza, Naples.—Nov. 15, 1864.

2948. L. Leister, Glasgow, N.B., "Improvements in obtaining bromine and bromides, and in apparatus therefor."—Nov. 25, 1864.

27. N. Thompson, Abbey Gardens, St. John's Wood, "Improvements in stoppers for bottles, jars, vessels, and tubes, also for ordnance and fire-arms."—Jan. 4, 1865.

88. R. A. Brooman, Fleet Street, "Improvements in engraving upon crystals, glass, and siliceous substances."—A communication from C. R. Maréchal and C. M. T. du Mortay, Metz, France.—Jan. 11, 1865.

481. R. Willison, Alloa, N.B., "Improvements in mashing machines, and in apparatus connected therewith."—Feb. 21, 1865.

CORRESPONDENCE.

Continental Science.

Paris, March 29.

Father Durand is not the first, I think, who has sought to establish a close analogy between sound and colour, inventing a gamut of colours, the harmonies and discords of which perfectly correspond to the musical intervals. The octave Do Do is represented by green and cherry red, and starting from this melodic base the Rev. Father finds the harmonic proportions and the charm of harmonies exactly to correspond with those of music. You want the Father's coloured atlas to show all this, but it is a very expensive book—costs, if I remember rightly, 450 francs, and I am afraid it will not be much looked at. The speculation certainly is curious, but there seems an absence of scientific foundation. A lively imagination, however, such as must have been possessed by the musician in the "Bohemians of Paris," who sat himself down to compose a symphony which was to describe the influence of the colour blue on art, will greatly assist in understanding Father Durand's reasoning. Somebody, Dr. Piesse, I rather think, imagined a gamut of odours, in which perhaps kakodyle and otto of roses constituted the octave, but I forget the harmonic proportions, concords, and discords.

The learned astronomer at Rome, Father Secchi, has again written to M. Faye on the subject of the spectra of the star α Orion, and of nebulæ. In this note he throws out the suggestion that the star just named is now in a state approaching nebulosity—that is, less advanced in its formation than stars properly so-called, and yet more condensed than the nebulæ proper. The strange spectrum of this star, he adds, seems destined to unveil one of the great mysteries of creation.

At the last meeting of the Academy M. C. St. Claire Deville announced that at the next meeting he would present the results of thermometric observations made during the last fifty-seven years, which among other things will show that shooting stars have a real influence on sudden variations of temperature.

Destruction of Parasites.

To the Editor of the Chemical News.

Sir,—In answer to your correspondent's letter respecting the application of bichromate of potash for the destruction of parasites, there is one mistake; either the gentleman gave some of the salt internally, or perhaps the dog licked himself: in this case death would be the result to any animal. I am sorry for the poor dog.

I am, &c. Israel Swindells.

[We can sympathise with our last week's correspondent on the loss of his dog, but it is some gain to have learnt that bichromate of potash is a virulent poison. We do not remember to have seen it so stated in any book. —Ed. *C. N.*]

Vapour-Densities.

To the Editor of the Chemical News.

Sir,—The report of my paper "*On Vapour-Densities*," which appeared last week, will, I am afraid, not be very intelligible to your readers. Perhaps a short sketch of it may not be deemed superfluous. I send, therefore, the following.

I would premise, however, that I was rather shocked to find your reporter attributing to Dr. Playfair and me experimental results which are not the product of our labour, but of the accumulated labours of chemists during the last fifty years or more.

In brief, the real purport of my paper is this:—

A vapour, no matter what its chemical composition may be, is a true gas—*i.e.*, it has the same rate, or very nearly the same rate, of expansion as air. This is proved by the correspondence between the theoretical vapour-density and the experimental vapour-density observed by so many chemists in a thousand instances.

The determinations of the vapour-density of chemical substances may be looked upon as an immense experiment, having for its object to give an answer to the question, Has the chemical constitution of a vapour anything to do with its rate of expansion?

As is well known, all that we do in making a vapour density determination of a substance is to compare the weight of a given volume of its vapour at a certain temperature and pressure with the weight of an equal volume of air at the same temperature and pressure.

The pressures at which vapour-densities have been taken are various, but, as a rule, have not exceeded the ordinary barometric pressure. The temperatures at which these determinations have been made are very varied indeed, ranging in general from 0°C. to 300° C.; but in a few instances (in the experiments of Deville and Troost, for example), as high almost as 1000° C. The composition of the substances which have been submitted to vapour-density determination presents the utmost variety, and still the actual results correspond closely with theory, and whenever pains have been taken with a vapour-density determination, the experimental number was very near to the theory. And here the remark may be made that, contrary to what might be imagined, very heavy vapours do not show any irregularity; indeed, such is the extreme regularity of iodine vapour (one of the heaviest of vapours), that Deville and Troost have employed it for thermometric purposes in their memorable research.

If difference of chemical composition occasioned difference in the rate of expansion, it would be impossible for our thousand different vapours to exhibit the theoretical vapour-density at the different temperatures at which they have been experimented upon. It must be borne in mind that the precise temperature at which any one substance has been examined has been always a matter of chance, the only rule to which chemists have adhered having been to allow an interval of not less than 30° or 40° to intervene between the boiling point of the liquid and the temperature at which the vapour was measured.

We have, then, as the result of a first-rate induction: "A vapour—no matter what its chemical composition—provided only it be exposed to not more than ordinary barometric pressure, and that it be not within 30° or 40° of the boiling point of its liquid, has the same expansion co-efficient as air."

Dr. Playfair and myself have extended this proposition. Instead of "not within 30° or 40° of the boiling point of its liquid," we propose "superheated 30° or 40°," and by effecting this superheating by diminution of pressure, we are able theoretically to place any vapour under this condition at any temperature. In how far we have practically realised this idea will be apparent on reference to our paper.

To set aside the above induction, some case wherein a vapour expands irregularly, and yet is known not to suffer decomposition, must be found. We have none such. In the instances which are usually urged to show an irregularity, so far from there being any guarantee of absence of decomposition, there is a high probability of it deducible from the chemical character of the substances concerned.

Given, that vapours expand like air; it follows that whenever two vapour-densities taken at different temperatures disagree, there must have been chemical change; and hence chemists would do well to select the lowest practicable temperature when they make a vapour-density determination from which a formula is to be deduced.

I am, &c. J. Alfred Wanklyn,
Professor of Chemistry at the London Institution.

On the "Ous-ic" System of Nomenclature.

To the Editor of the Chemical News.

Sir,—In a highly interesting and important paper lately read before the Chemical Society, Dr. Williamson has proposed that chemists should adopt and more fully carry out the plan of naming compound bodies largely made use of in Gmelin's "Handbook of Chemistry." Before, however, suggestions proceeding from so distinguished a chemist become more generally employed, I trust that I may be permitted, through your columns, to draw attention to certain objections of a weighty character to such a system of nomenclature—objections which have indeed been already urged by myself and others at the meetings of the Chemical Society, but which have not yet, to my knowledge, made their appearance in a written form.

In the first place, then, such names do not indicate with any degree of precision the composition of the substances to which they are attached. For instance, what does the name "stannic oxide" imply? An oxide of tin containing more oxygen than stannous oxide. And what is stannous oxide? An oxide of tin containing less oxygen than stannic oxide.

These names, therefore, give us no information as to the number of atoms of oxygen in a given oxide; they simply say that it contains more or less oxygen than another oxide of the same element, which may or may not exist. Names like "potassic oxide" or "sodic oxide" might even induce a beginner to suppose that there existed lower oxides of potassium and sodium, for which the termination "ous" was reserved. It may, indeed, be argued that such names are preferable during the rapid transformations that chemical notation has lately undergone. Thus the name "nitrous oxide" serves to designate the lowest oxide of nitrogen, and the name "nitric oxide" that immediately above it, whether we view the former as N_2O or NO, or the latter as NO or NO_2. But why do they so serve? Simply from their want of precision. Names like "protoxide" and "binoxide," which usually convey to the mind a precise and perfectly definite idea, must of necessity be altered with the progress of science; but this offers no great drawback to their use. Most of the objections that apply to a change of names apply with equal force to a change of formulæ. If, after many variations, we have arrived at our present formulæ, why should we be ashamed to give them consistent names? Why should not water, H_2O, be called the suboxide of hydrogen, or hydric suboxide; laughing gas, N_2O, the suboxide of nitrogen, or nitric suboxide; and nitric oxide the protoxide of nitrogen, or nitric protoxide? Even on the "ous-ic" system the name "nitric oxide" is not correctly applied; for surely the substance miscalled nitric anhydride N_2O_5 has more oxygen in it, and therefore has a better claim to the title of nitric oxide.

The second objection is, that analogous bodies do not have analogous names assigned to them. For instance, the protosulphates of magnesium, iron and copper, are called on this system magnesium sulphate, ferrous sulphate, and cupric sulphate. Here we have three distinct terminations employed to indicate three perfectly analogous compounds; and clearly one great defect of such a system is, that it causes us to lose sight of most important analogies. In the case of the copper compound, this difficulty might be, no doubt, smoothed down by calling the red oxide of copper hypocuprous oxide, and the blue oxide cuprous oxide; when blue vitriol would become cuprous sulphate, analogous to green vitrol, or ferrous sulphate. Even then Rose's quadrantoxide of copper would loom in the distance, and how that stupendous shade should be named on the "ous-ic" system I hardly venture to surmise—unless, indeed, it were termed the subhypocuprous oxide. I am, &c.

John A. R. Newlands, F.C.S.

Laboratory, 19, Great St. Helens, E.C., March 20.

MISCELLANEOUS.

Iron and Steel Foil.—A short time since we described the successful results of recent efforts in the direction of manufacturing sheet iron and steel of extraordinary tenuity. The foreign specimens to which allusion was then made appear to have been surpassed by the sheets of rolled steel which have lately been produced by Mr. Parry, of Ebbw Vale. One of these samples of steel foil, which we had an opportunity of inspecting, was much thinner than ordinary writing paper, and weighed only one and a-half grain per square inch, or less than half an ounce per foot super. The outer surfaces, although slightly blackened with oxide, were remarkably uniform, and the texture throughout was perfectly compact. The production of these metallic foils will probably lead to new and interesting applications of sheet iron in the arts.

ANSWERS TO CORRESPONDENTS.

X. A.—They depend upon what is to be done, and vary in properly regulated places.

Saggar will find some information in Richardson's and Watts' "Technology," but the subject has never been fully treated of.

J. J. is postponed until next week.

E. H.—Professor Way, we believe, used Bunsen's battery, the number of cells depending upon the light to be produced. The light can hardly be said to have failed, but it has not come into use.

Books Received.—"Book of Perfumes," by E. Rimmel. Dr. Hunt, "On Stammering."

Received with thanks.—Mr. Balfour Stewart; Dr. Redwood; "The Writer of the Article, &c."

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

An Introduction to Chemical Philosophy, according to the Modern Theories, by ADOLPHE WURTZ, *F.R.S.*

PART I.

EQUIVALENTS, ATOMIC WEIGHTS AND MOLECULAR WEIGHTS.

SECTION II.—*New System of Atomic Weights.*

(Continued from page 147.)

2. The new system of atomic weights is in harmony with the law of isomorphism.—Isomorphous bodies are, in fact, represented by analogous formulæ. Thus cuprous sulphide, which is isomorphous with sulphide of silver, Ag_2S, is represented by the formula Cu_2S,[*] whilst Gerhardt gives it the formula Cu_4S.[†] Sulphate of silver and anhydrous sulphate of sodium receive the analogous formulæ

$$SAg_2O_4 \text{ and } SNa_2O_4.$$

The isomorphous sulphates of the magnesian series are represented by the formula

$$SMO_4+7H_2O.$$

The double sulphates of the same series receive the formula

$$SMO_4+SR_2O_4+6H_2O.$$

Lastly, the composition of alums is represented by the formula

$$S_3R_2O_{12}+SR_2O_4+24H_2O.$$

3. The new system of atomic weights is in harmony with the relations existing between the densities of gases and vapours, and their molecular weights.—1. Let us first consider the relations discovered by Gay-Lussac between the densities of simple gases and their atomic weights. With some exceptions these densities are proportional to the atomic weights, in such a manner that if, instead of being compared with air, they are compared with hydrogen taken as unity, the same numbers will express their densities and atomic weights. The following table will show this [‡]:—

Names of Simple Bodies.	Densities of gases and vapours compared with air.	Densities compared with hydrogen.	Atomic weights.
Hydrogen . .	0·0693	1	1
Oxygen . .	1·1056	15·9	16
Nitrogen . .	0·9714	14·0	14
Sulphur (at 1000°)	2·22	32·0	32
Chlorine . .	2·44	35·2	35·5
Bromine . .	5·393	77·8	80
Iodine . .	8·716	125·8	127

It was upon the remarkable relation between the densities and atomic weights that this celebrated proposition of Ampère and Berzelius was chiefly founded: *equal volumes of gases contain the same number of atoms.* One atom of the preceding gases corresponds to one volume. We shall see that, slightly modified, this proposition is also applicable to compound gases.

But we ought not to pass over in silence the exceptions which have been discovered to the preceding law. Phosphorus, arsenic, mercury, and cadmium diverge from it. The densities of their vapours compared with that of hydrogen are not the same as their atomic weights. They only present a simple relation with their atomic weights, as shown by the following figures:—

Names of Simple Bodies.	Vapour densities compared with air.	Vapour densities compared with hydrogen.	Atomic weights.
Phosphorus . .	4·42	63·8	31
Arsenic . .	10·6	153·0	75
Cadmium . .	3·94	56·9	112
Mercury . .	6·976	100·7	200

It is seen that the vapour densities of phosphorus and arsenic lead to double the atomic weights assigned to these elements, whilst, on the contrary, the vapour densities of cadmium and mercury give atomic weights half as great as those which belong to them. In other words, the first two vapour densities are twice as large as they should be; the second are half as large, and whilst the atoms of other gases correspond to one volume, those of phosphorus and arsenic correspond to half the volume, and those of mercury and cadmium correspond to two volumes.

With phosphorus and arsenic the anomaly is of the same character as that presented by the vapour of sulphur at 500°, but the vapours of the former two elements do not appear to expand like that of sulphur at higher temperatures so as to be brought to their normal densities. It is, however, possible that this phenomenon of expansion does not commence, in the case of these very dense vapours, except at temperatures inaccessible to our means of investigation.

Mercury and cadmium, to which must probably be added zinc, present an inverse anomaly; their vapours, in the free state, are too little condensed. We will endeavour presently to explain this fact by comparing these metals with certain organic radicals which offer analogous phenomena. At present it remains for us to show that these exceptions do not embarrass the theory. They are apparent when the bodies in question are examined in the free state, but they disappear when the most definite compounds of these same bodies are taken. When combined with hydrogen, chlorine, bromine, iodine, and with organic radicals the bodies in question, that is to say phosphorus, arsenic, mercury, and zinc, possess their normal vapour density. To show that this is so, it is necessary to recall and to accurately define the relations which exist between the atomic composition of compound bodies and their densities in the state of gas or vapour.

II. These relations are of the most simple character, and it may be expressed by saying that *equal volumes of gases contain the same number of molecules* under identical conditions of temperature and pressure, and that consequently the *molecular weights of compound bodies are proportional to their densities in a state of gas or vapour.* This is the proposition of Ampère and Berzelius slightly altered in its wording, and applicable in its new form to simple as well as to compound gases. It here refers to molecules, and not to atoms, for it is evident that compound gases do not always contain, for the same volume, the same number of atoms, in the sense which we have used this word.

In fact, we know that 2 volumes of hydrochloric acid contain 1 volume or 1 atom of chlorine, and 1 volume or 1 atom of hydrogen—that is to say, 2 elementary atoms; whilst 2 volumes of ammonia contain 1 volume, or 1 atom of nitrogen and 3 volumes or 3 atoms of hydrogen—that is to say, altogether 4 elementary atoms. Experience teaches us, on the other hand, that 2 volumes of hydrochloric acid combine with 2 volumes of ammonia. We are, therefore, led to regard the quantity of

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[*] $Cu=63·4$; $S=32$.

[†] $Cu=31·7$; $S=32$.

[‡] To reduce the densities of gases to that of hydrogen, it is only necessary to multiply them by $14·44=\frac{1}{0·0693}$, which is the ratio between the density of air and that of hydrogen.

hydrochloric acid which contains 1 atom of chlorine and 1 atom of hydrogen (and which corresponds to 2 volumes) as representing 1 molecule of this acid; and to look upon the quantity of ammonia which contains 1 atom of nitrogen and 3 atoms of hydrogen (and which corresponds to 2 volumes) as representing 1 molecule of ammonia. Thus hydrochloric acid and ammonia contain for the same volume an equal number of molecules, and it is the same for the other compound gases.

In the case of hydrochloric acid and ammonia, which we will continue to take as examples, their molecular weights correspond in consequence to weights of two volumes of each gas—that is to say, to their double density, for the density represents the weight of one volume (or unit of one volume). If, therefore, the densities of these two gases were expressed in relation to hydrogen, which represents unity in the system of atomic weights, it would be sufficient to double the numbers expressing these densities to obtain their molecular weights. That is to say, to obtain the latter the densities found in relation to air must be multiplied by twice the ratio of the density of air to the density of hydrogen, or by—

$$2 \times \frac{1}{0{\cdot}0693} = \frac{2}{0{\cdot}0693} = 28{\cdot}88.§$$

Let us, therefore, make the calculations we have just given, not only for compound bodies, but also for the elements, and let us group the bodies in such a manner as to bring out certain analogies. We shall thus find the molecular weights of all these bodies; we can construct their formulæ, and can verify if the atomic weights deduced from the vapour-densities of compound bodies are identical with those we have already given. In the following table the numbers inscribed in the third column represent the double densities of volatile substances compared with hydrogen; these numbers agree sensibly with those given in the fourth column, and which represent the molecular weights deduced from chemical considerations.

Names of bodies.	Densities.	Double densities, as compared with hydrogen.	Molecular weights.	Formulæ.
Hydrogen . . .	0·0693	2·0	2	H_2
Chlorine . . .	2·44	70·5	71	Cl_2
Bromine . . .	5·54	159·0	160	Br_2
Iodine . . .	8·716	251·7	254	I_2
Cyanogen . . .	1·806	52·1	52	Cy_2
Methyl . . .	1·0365	29·9	30	Me_2
Hydride of methyl .	0·558	16·1	16	MeH
Ethyl . . .	2·0462	59·09	58	Et_2
Oxygen . . .	1·1056	31·9	32	O_2
Sulphur . . .	2·22	63·5	64	S_2
Water . . .	0·6235	18·	18	H_2O
Sulphuretted hydrogen	1·1912	34·4	34	H_2S
Sulphurous acid .	2·234	64·5	64	SO_2
Sulphuric acid . .	2·763	79·8	80	SO_3
Nitrogen . . .	0·9714	28·0	28	N_2
Protoxide of nitrogen	1·527	44·1	44	N_2O
Binoxide of nitrogen.	1·038	29·98	30	NO
Hyponitric acid .	1·72	49·5	46	NO_2
Methylamine . .	1·08	31·19	31	$NMeH_2$
Ammonia . . .	0·591	17·07	17	NH_3
Phosphorus . .	4·42	127·6	62	P_4‖
Phosphuretted hydrogen . . .	1·184	34·2	34	PH_3
Protochloride of phosphorus . . .	4·742	136·9	137·5	PCl_3
Oxychloride of phosphorus . . .	5·3	153·1	153·5	$POCl_3$
Arsenic . . .	10·6	306	150	As_4¶
Arseniuretted hydrogen . . .	2·695	77·8	78	AsH_3
Chloride of arsenic .	6·3006	181·9	181·5	$AsCl_3$
Iodide of arsenic .	16·1	464·9	456	AsI_3
Triethylarsine . .	5·61	162·0	162	$AsEt_3$
Kakodyle (arsen-bimethyl) . .	7·1	205·0	210	As_2Me_4
Oxide of carbon .	0·967	27·9	28	CO
Carbonic acid . .	1·529	44·1	44	CO_2
Marsh gas . .	0·559	16·1	16	CH_4
Chloroxycarbonic gas (chloride of carbonyl)	3·399	98·2	99	$COCl_2$
Chloride of carbon .	5·415	156·4	154	CCl_4
Sulphide of carbon .	2·645	76·4	76	CS_2
Chloride of silicium .	5·939	171·5	170	$SiCl_4$
Silicium-ethyl .	5·13	148·1	144	$SiEt_4$
Fluoride of silicium .	3·600	103·9	104	$SiFl_4$
Tetrethylic silicate .	7·325	211·5	208	$Si(EtO_4)$
Perchloride of tin .	9·199	265·7	260	$SnCl_4$
Stannotetrethyl (stannethide) .	8·021	231·6	234	$SnEt_4$
Stannodiethyl - dimethyl . .	6·838	197·5	206	$Sn\left\{\begin{matrix}Et_2\\Me_2\end{matrix}\right.$
Chloride of Stannotriethyl (of sesquistannethyl	8·430	243·4	240·5	$Sn\left\{\begin{matrix}Et_3\\Cl\end{matrix}\right.$
Bromide of stannotriethyl .	9·924	286·6	285	$Sn\left\{\begin{matrix}Et_3\\Br\end{matrix}\right.$
Iodide of stannotrimethyl .	10·32	298	290	$Sn\left\{\begin{matrix}Me_3\\I\end{matrix}\right.$
Dichloride of stannodiethyl .	8·710	251·5	247	$Sn\left\{\begin{matrix}Et_2\\Cl_2\end{matrix}\right.$
Dibromide of stannodiethyl .	11·64	336·1	336	$Sn\left\{\begin{matrix}Et_2\\Br_2\end{matrix}\right.$
Chloride of zirconium	8·15	235·4	331	$ZrCl_4$
Chloride of titanium.	6·836	197·4	192	$TiCl_4$
Chloride of boron .	3·942	113·7	117·5	$BoCl_3$
Bromide of boron .	8·78	253·6	251	$BoBr_3$
Fluoride of boron .	2·3694	68·4	68	$BoFl_3$
Boracictriethyl .	3·4006	98·2	98	$BoEt_3$
Boracictrimethyl .	1·9314	55·8	56	$BoMe_3$
Trimethylic borate .	3·59	103·7	104	$Bo(MeO_3)$
Triethylic borate .	5·14	148·4	146	$Bo(EtO_3)$
Chloride of vanadium	6·14	177·3	175	VCl_3
Chloride of antimony	7·8	225·3	228·5	$SbCl_3$

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§ This fact may be established in another way; equal volumes of simple or compound gases contain the same number of molecules, the molecular weights of which are in proportion to their densities. Thus the density of hydrochloric acid is to the density of hydrogen as the molecular weight of hydrochloric acid is to the molecular weight of hydrogen: this latter is = 2, for it corresponds to two atoms. The molecular weight of hydrochloric acid is obtained, consequently, by the following proportion:—

$$\frac{1{\cdot}247}{0{\cdot}0693} = \frac{x}{2}, \text{ whence } x = 1{\cdot}247 \times \frac{2}{0{\cdot}0693}$$

Thus, to find the molecular weight, it is only necessary to multiply the densities by the constant ratio $\frac{2}{0{\cdot}0693} = 28{\cdot}88$. The numerator 2 thus represents the molecular weight of hydrogen. We have given above the reasons which have induced MM. Dumas and Gerhardt to look upon free hydrogen—that is to say, one molecule of hydrogen—as formed of 2 atoms. Other simple bodies have been regarded in the same light.

‖ It is seen that the molecular weights of phosphorus and arsenic, as deduced from their vapour densities, are double those which their analogy to nitrogen would lead to be given to them. Whilst the molecule of free nitrogen is N_2 = 2 vols., the molecules of free phosphorus and arsenic are P_4 and As_4 = 2 vols.

¶ See note ‖.

Names of bodies.	Densities.	Double densities, as compared with hydrogen.	Molecular weights.	Formulæ.
Triethylstibine (stibethyl) . . .	7·23	208·8	209	$SbEt_3$
Chloride of bismuth.	11·35	327·8	316·5	$BiCl_3$
Oxychloride of chromium . . .	5·5	158·8	156·5	CrO_2Cl_2
Chloride of aluminium	9·34	269·7	268	Al_2Cl_6
Bromide of aluminium	18·62	537·7	535	Al_2Br_6
Iodide of aluminium.	27·0	779·8	817	Al_2I_6
Perchloride of iron .	11·39	328·9	325	Fe_2Cl_6
Osmic acid . .	8·89	256·7	263·2	OsO_4
Zinc-ethyl . .	4·259	123	123	$ZnEt_2$
Mercury . . .	6·976	201·4	200	Hg''
Chloride of mercury.	9·8	283	271	$HgCl_2$
Bromide of mercury.	12·16	351·2	360	$HgBr_2$
Iodide of mercury .	15·9	459·2	454	HgI_2
Mercuric dimethyl .	8·29	239·4	230	$HgMe_2$
Mercuric diethyl .	9·97	287·9	258	$HgEt_2$
Mercurous chloride .	8·21	237·1	235·5	$HgCl$
Mercurous bromide .	10·14	292·8	280	$HgBr$
Ethylene . . .	0·9784	28·2	28	$[C_2H_4]''$
Chloride of ethylene.	3·4434	99·4	99	$[C_2H_4]''Cl_2$.

The results which are given in the preceding table suggest the following remarks:—

Firstly, if the law of Ampère is applicable to simple as well as to compound bodies, either in the state of gas or vapour, it will be seen that the molecules of both correspond to two volumes of vapour.

Secondly, the exceptions to this law, which are apparent in the case of several simple bodies, will not apply to volatile compounds of the same bodies. Phosphorus, arsenic, mercury, cadmium, and zinc, in their combinations with hydrogen, chlorine, bromine, iodine, and organic radicals, give such vapour-densities that the atomic weights deducible from them, conformably to the law of Ampère, are the same as the atomic weights founded upon chemical considerations.

Thirdly, the molecular weights which may be deduced, conformably to this law, from the densities of a great number of combinations, are identical with the molecular weights deduced from chemical considerations, provided that numbers which agree with the law of Dulong and Petit are taken for the atomic weights of a great number of elements.

(To be continued.)

Contributions to the History of the Metals in Cerite and Gadolinite, by M. Marc Delafontaine.*

In 1788 Captain Arrhenius discovered in the quarries at Ytterby a black mineral, which Gadolin analysed six years afterwards, and which he discovered contained a new earth.

Ekeberg gave to the mineral the name of *gadolinite*, and to the earth that of *yttria*. In spite of appearances to the contrary, the latter was found to be far from constituting a homogeneous substance, for in 1802 Ekeberg extracted glucinium from it, Berzelius cerium in 1815, Mosander lanthanium and didymium in 1839, and erbium and terbium in 1843. The second, third, and fourth of these bodies is found in much greater abundance in the cerite of Bastnaes.

The seven bodies above enumerated have been, since their discovery, the subject of several important works; but it is to be regretted that their history has not advanced in the same ratio, as, in spite of the well-merited confidence inspired by Mosander's works, the existence of erbium and terbium is generally regarded as problematical, and even in those which are best known a great many essential points remain to be elucidated.

In the first place, none of them except glucinium has been obtained in a free state. It will probably be found in time that the powders described as cerium, didymium, yttrium, &c., do not give a correct idea of these isolated metals. Each of them forms a powerful salifiable protoxide base, but the superior and inferior degrees of oxidation, if there are any, remain almost or wholly unknown. Thus, for instance, cerium gives an oxide Ce_3O_4, capable of forming well-defined salts; but does its sesquioxide exist? Mosander, Marignac, and Rammelsberg have never obtained it, while Hermann says that it forms readily, and besides admits the existence of a more oxygenated compound. According to Göbel, the cerous formiate, excluded from the air and calcined, is reduced to the metallic state. This is probably incorrect, but the reducing properties of formic acid being ascertained, what is the composition of the residue obtained by Göbel? Didymium partially superoxidises so as to unite with oxygen in the atomic proportion of about 32 to 33. It is the same with erbium, and probably with lanthanium also. Is this exception to the general law of multiple proportions an acquisition to science, or may oxidation be carried still further, and if so, what is its limit? Or again, as certain facts would lead us to suppose, is the small excess of oxygen absorbed by some new metal, which will be brought to light by future researches? &c.

Having at my disposal abundant materials for the elucidation of all these points, and having during the last few years become well acquainted with the reactions of the metals in cerite and gadolinite, I devoted to them a series of researches, the results of which I will give in several successive memoirs.

1. On Erbium and Oxide of Erbium.—Scheerer observed that yttria, heated in a current of hydrogen, loses its yellow colour, and recovers it after calcination in the air. The alteration of weight during these two operations being so small, Scheerer concluded that some foreign oxide must be present in the yttria, probably the recently discovered oxide of didymium.

Mosander undertook some researches on this subject, and in 1843 ascertained that the body called yttria is in reality a mixture of three salifiable oxides, two of which, the most powerful, are white and the third yellow. Mosander gives them the names of yttria, terbium, and erbium, and gives a method of separating them, and their chief characteristic reactions. His results were confirmed by Berzelius, Svanberg, and Scheerer.

Since then erbium, terbium, and yttria have not, to my knowledge, been made the subject of any fresh researches, and even the existence of the first two is not, as I have already stated, universally admitted.

In 1841 M. Plantamour collected at Ytterby a large quantity of gadolinite and yttrotantalites, which, with his accustomed kindness, he placed at my disposal, and which formed the subject of studies the results of which are as follows:—

My object was again to prove the existence of erbium and terbium, and, this being accomplished, to complete their history according to the characteristics which most distinguished them, either one from another or from analogous earths. For this purpose the best plan appeared to me to be to repeat and at the same time to extend Mosander's experiments. I will first speak of

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* *Archives des Sciences Physiques et Naturelles, Geneva.*

erbium and then of terbium and yttria, ending by a chemical and crystallographic examination of the salts of which I treat.

It seemed to me superfluous to seek for a new process for extracting yttria from gadolinite and separating it from the accompanying bases, so I confined myself to the path indicated by Berzelius in his *Traité de Chimie.*

Yttria being obtained free from lime, manganese, glucina, cerium, &c., I had the choice of several methods for extracting erbium and terbium. After several comparative trials, I determined on employing binoxalate of potash to effect the fractional precipitations on which is founded the separation of the three earths. In this instance I proceeded as follows:—

After having dissolved yttria in nitric acid and acidulated the filtered liquid with a little sulphuric acid, I heated the liquid to 70° or 80° C., and then added to it, drop by drop, a cold saturated solution of binoxalate of potash. A precipitate was thus formed, which immediately redissolved by shaking, until a last drop produced permanent turbidity. I then stopped adding the reagent, and left the whole to stand for several days. At the end of this time there was formed at the bottom of the glass, and on portions of the sides which had been rubbed by the rod, a crystalline deposit of a potassico-earthy oxalate, which was separated by filtration. This operation repeated fifteen times under exactly the same conditions invariably gave oxalates, which left after calcination a yellow residue, from which water separated carbonate of potash. From this number the precipitates obtained were less crystalline, had a scarcely appreciable rose tint, and gave only an almost colourless earth. According to the depth of their colour, these residues were assorted and united in two lots, to be treated as will be described.

(To be continued.)

On Some of the Reactions of Monochloric Ether.

MONOCHLORIC ether

$$\left.\begin{matrix}C_2H_4,Cl\\C_2H_4,Cl\end{matrix}\right\}O$$

is decomposed when acted on by alcohol and acetate of potash simultaneously, as is shown by the following equation:—

$$\left.\begin{matrix}C_2H_4Cl\\C_2H_4Cl\end{matrix}\right\}O+\left.\begin{matrix}C_2H_5\\H\end{matrix}\right\}O+\left.\begin{matrix}K\\C_2H_3O\end{matrix}\right\}O$$

$$=KCl+\left.\begin{matrix}H\\C_2H_3O\end{matrix}\right\}O+\left.\begin{matrix}C_2H_4C_2H_5O\\C_2H_4\quad Cl\end{matrix}\right\}O$$

Besides chloride of potassium and acetic acid, a new body is formed, which may be considered as ether, in which one equivalent of hydrogen is replaced by chlorine, and in the place of another equivalent of hydrogen C_2H_5O, oxide of ethyl has entered. This substance boils at 155° Cent., and its vapour has a pleasant smell; and was some short time since discovered by Liebig amongst other products formed when ethylate of soda acts on monochloric ether, but which could not then be obtained in a pure state. Anhydrous oxide of silver acts very energetically on monochloric ether, or on a solution of monochloric ether in ether forming the same new substitution product. Dry acetate of oxide of silver acts on monochloric ether when the temperature is considerably raised; and amongst other products formed in this reaction the following substance was discovered:—

$$\left.\begin{matrix}C_2H_4C_2H_3OO\\C_2H_4\quad Cl\end{matrix}\right\}O$$

This body is also to be considered as monochloric ether, in which one equivalent of chlorine has been replaced by the radical $C_2H_3O_2$. This substance has a strong penetrating odour, and boils at about 170° Cent., and by distillation is slightly decomposed, forming acetate of ethyl; but by a solution of caustic potash completely so. Formiate of oxide of lead reacts on monochloric ether in the same manner as acetate of oxide of silver, only the reaction takes a much longer time before it is completed.

The above researches will allow us to hope that the salts of the fatty acids, when acting on monochloric ether, will give a series of compounds which may be represented by the following general formula:—

$$\left.\begin{matrix}C_2H_4CnH_2n-1O_2\\C_2H_4\quad Cl\end{matrix}\right\}O$$

and should we also be able to replace the second equivalent of chlorine in monochloric ether by a radical of the general formula CnH_2n-1O_2, we shall have another series of compounds, represented by the general formula

$$\left.\begin{matrix}C_2H_4CnH_2n-1O_2\\C_2H_4CnH_2n-1O_2\end{matrix}\right\}O.$$

The results of this further research will be communicated at some later period.—*Extract of a paper read by Dr. Alexander Bauer*, Professor of Chemistry at the Imperial Academy of Science, Vienna, December 1, 1864.

Action of Sodium on Carbonic Ether, by M. H. GAL.

CARBONIC ether is formed by the reaction of sodium on oxalic ether, and it is usually said that the action of the metal must be continued as long as gas is disengaged. But if this is done no carbonic ether will be obtained, for the sodium acts on the ether, and if the re-action be stopped at the proper time a considerable quantity of a liquid boiling at 79° is obtained. Sodium acts on this liquid also with disengagement of hydrogen; it is soluble in water, and analysis attributes to it the formula of alcohol. The formation of this compound is inexplicable by any equation the author can imagine.

On the Supposed Nature of Air prior to the Discovery of Oxygen, by GEORGE F. RODWELL, *F.C.S.*

(Continued from page 76.)

XI. Rise of Scientific Societies.—Inasmuch as in the following papers we shall have frequently to allude to the labours of various scientific societies in connection with the subject under consideration, and as, moreover, institutions of this nature have done much to further the progress of experimental philosophy, I conceive it will not be out of place here to give a short account of their rise, and of their effect on the progress of physical science.

Among the ancients there was no experimental philosophy; we read of a few isolated experiments—such as the electrical experiment of Thales, the proof of the materiality of air proposed by Anaximenes, and the magnetic experiment mentioned by Lucretius—but these were exceptions; men preferred to rely on the unaided intellect rather than to call in assistance from external sources; they preferred to give a theoretical explanation of a natural phenomenon, and to reason on that, all unproven as it was, as if it were a well-established and absolute truth. Let any one read the "Physics" of Aristotle if he wishes to comprehend the tone of physical thought which prevailed among the ancients. Such a treatise is intolerable to a follower of the Baconian method; the long, dreary trains of reasoning, perpetually ramifying in all directions, and the continued proposal of one theory to support another, so divert the mind from the subject discussed, that it ultimately grasps the explanation with difficulty. Such a system has no solid basis; destroy one theory in any part of the explanation, and the whole mass of reasoning in a moment falls to the ground. When we remember that this was the scientific text-book for 2000 years, can it be wondered that the physical sciences are now almost new born in the world?

Passing onward to this side of the Christian era, we find a manifest lessening of intellectual activity; the golden age of literature among the ancients had passed away. Greece for a long period had ceased to furnish writers of eminence; the Romans, tired of conquest, became indolent, luxury and corruption followed, and, as a consequence, enervation of intellectual power. Then came those uncivilised Northern races, which, in destroying the Roman Empire, at the same time crushed all traces of learning; but that unyielding besom, while it swept away a debased and impoverished literature, did also remove the causes which had conduced to its impoverishment.

From the time of the destruction of the Roman Empire till the fifteenth century, science, in common with all other pursuits depending on mental energy, was utterly neglected. There could be but little learning during the Middle Ages. The priests were the most educated members of the community, and on that account they possessed immense power over the human mind, for on them devolved not only spiritual but also temporal teaching. But they were an ignorant class of men, and cared for nought but to uphold and maintain the dominion of their Church, and their own dominion over the minds of men. There could be no scientific progress; for had not that Church, now dominant and supreme, condemned the study of physical science? had it not affirmed that the Aristotelian philosophy was sufficient for all purposes, and ruled that it alone should be followed? In the fifteenth century the power of the Church began to wane; Savonarola had arisen, and had waged war against the absolute dominion of the hierarchy; Sarpi was soon to appear; a few had ventured to dispute the authority of Aristotle in physical matters, and had been punished for their freedom of thought. The human mind began to arouse itself after its long imprisonment, and to strive to burst asunder its fetters, for the Church had at first bound it captive with silken threads easy to be broken, but eventually they became fetters of steel. A yearning for intellectual progression was apparent, a desire to employ the long neglected attribute of reason; and now in that land in which more than a thousand years before learning had been almost blotted out, there arose a regenerated intellect—a new tone of thought; Italy was the cradle in which it gained vigour, and it passed out thence to civilise the whole world.

Among the greatest experimental philosophers of the Middle Ages, I may mention Roger Bacon[*], Albertus Magnus, the Spanish philosopher Averröes, and Leonardo da Vinci. We may briefly refer to the first and last of these.

The sixth part of Bacon's "Opus Majus"[†] bears the title "De Scientia Experimentalis." The first chapter treats "of the utility of experimental science;" the last "of the dignity of the experimental arts." Throughout the work we find a strong advocacy of experiment as a guide to the intellect to assist it in arriving at the causes of unusual physical effects. No treatise at all comparable to this appeared during the Middle Ages—indeed, not until the publication of the "Novum Organum."

Leonardo da Vinci[‡] is known to every one as a great painter, but it is not so generally known that he was a great mathematician, physicist, and engineer, and by no means an inferior musician. His physical views are far in advance of those of either his own or the succeeding age; our chief knowledge of them is derived from some of his unpublished MSS., which are preserved in the King's Library at Paris; many of these were translated into French by Venturi, and published in 1797.[§]

The following passage is written in the true spirit of inductive philosophy; indeed, no one who has read the "Novum Organum" can fail to be reminded of many similar passages therein:—"*Of Method.*—Theory is the general, practice the soldiers. The interpreter of the artifices of Nature is experiment. It never deceives; it is our judgment that sometimes deceives itself, because it expects results which experiment refuses. We must consult experiment, varying the circumstances until we have deduced general rules, for it alone can furnish reliable rules. But you ask me, of what advantage are these rules? I answer that they guide us in the researches of Nature, and the operations of art. They prevent us from deceiving ourselves or others by promising ourselves results which we cannot obtain."

I may also mention a sentence bearing directly on our subject, in which we have proof of most advanced physical knowledge for the period, and which shows that Leonardo da Vinci was aware that fire is not elemental, and that it requires air for its sustenance—a theory, I need not say, wholly at variance with that maintained by his contemporaries:—"*Of Flame and Air.*—There is smoke in the centre of the flame of a wax candle, because the air which enters into the composition of the flame cannot penetrate to the middle of it. It stops at the surface of the flame, and condenses there; in becoming aliment of the flame, it is transformed into it, and leaves a void space which is filled successively by other air."

In the middle of the sixteenth century the Church armed itself with a new and powerful weapon to suppress free thought; this was the right which it assumed of prohibiting the printing and reading of certain books which were believed to inculcate injurious ideas. The first catalogue of prohibited books was published by Paul IV. in 1559. In it no less than sixty-one printers were condemned, and *all* works issuing from their presses were forbidden to be read. Theological treatises were not the only works submitted to examination, scientific works did not escape; thus I find at the commencement of Baptista Porta's four books "De Aëris Transmutationibus," an order from the examiner allowing them to be printed, because, he writes, "in quibus nihil inveni, quod sit contra fidem, aut bonos mores."[‖]

Towards the end of the sixteenth century, we find a greater freedom of physical thought beginning to be

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[*] Born 1214. Died 1284.

[†] "Fratris Rogeri Baconis, Opus Majus." Ad Clementum Quartum. Ex M. S. Codice Dubliniensi cum aliis quibusdam collato, nunc primum edidit S. Jebb, M.D. Londini, 1733.

[‡] Born 1452. Died 1519.

[§] "Essai sur les ouvrages physico-mathematiques de Leonard da Vinci, avec des fragmens tirés de les manuscrits." Par J. B. Venturi. Paris. An v. (1797.)

[‖] The order is conveyed in the following form:—
"Imprimatur, si videbitur R.P.M. Sacri. Pal. Apost.
"Cæsar Fidelis Vices-gerens.
"Iussu Reurendissimi P. F. Ludouici Ystella Sacri Palitij Magistri. Ego Alexander de Angelis Societatis Iesu, et Sacræ Theologiæ Professor, legi quatuor libros Meteororum Io. Baptistæ Portæ Neapolitani, in quibus nihil inveni, quod sit contra fidem, aut bonos mores, sed dignos eos indico qui in lucem prodeant, si ita videbitur ijs, quorum interest. Data in nostro Collegio Romano die 22 Novembris, 1603.
"Ego Alexander de Angelis qui supra."

apparent; many eminent men now arose, among them may be mentioned Telesio, Aconcio, Nizzoli, our countryman Gilbert, Giordano, Bruno, and Galileo, great and original thinkers, worthy to be reverenced in all ages, for they broke down the barriers which had so long protected the Aristotelian philosophy, and by so doing prepared the world for the change about to be effected by the cardinal and sovereign intellect of Francis Bacon. Giordano Bruno suffered at the stake for the too open expression of his views; Galileo was compelled to resign his lectureship at Pisa, because he proved the fallacy of Aristotle's theory in regard to the velocity of falling bodies; at a later date he was imprisoned for daring to promulgate the Copernican theory of the earth's motion:—these were the last great efforts of the hierarchy to curb and restrain the workings of the human mind, the last acts of oppression to be practised by a long dominant Church.

Although the Aristotelian philosophy had long been falling into disrepute, no system at all comparable to it had been propounded, and it was not till the publication of Bacon's "De Augmentis Scientiarum," that it received its death blow. Mankind was now taught to interrogate Nature, not by reason alone, but by reason aided by experiment; not by the use of the syllogism, but by induction. From this period commences the epoch of modern science.

A few literary societies appeared in Italy in the fifteenth century, but their formation was not encouraged; in 1468 Paul II. arrested the members of a literary society on the charge of introducing foreign superstitions; they were ordered to be tortured and imprisoned for a year.

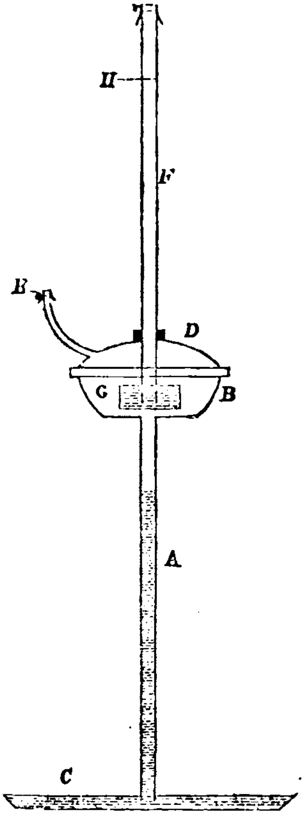
In the sixteenth century societies became much more numerous; they existed, however, almost exclusively in Italy, and were generally devoted to the improvement of the Italian language, or to the study of the Platonic philosophy.

The first scientific society was established by Baptista Porta in the middle of the fifteenth century. It was called the "Academy of the Secrets of Nature," and consisted solely of men who had discovered something of importance in medicine or natural philosophy. From the name of the society it was believed that magic and illicit arts were practised by its members, Porta was summoned to appear at Rome, and commanded by Paul III. to discontinue the meetings of the society. While in Rome he was elected a member of the "Lyncean," a very celebrated academy, to which Galileo also belonged.

The first scientific society of importance was the Accademia del Cimento, established in Florence in 1657 by Duke Leopold of Tuscany. The object of this society was "to make experiments and relate them," and to ignore all theoretical matter. It proved worthy of its name "del Cimento," but, unfortunately for science, it endured only ten years, for Leopold was created a cardinal in 1667, and by leaving Florence withdrew his direct patronage from the society. During the ten years of its existence, however, a large number of experiments were made by its members. A volume containing an account of them was published by the Secretary in 1667,¶ from which we extract the following relating to the subject under consideration.

In the early part of the work we find the description of a method of determining the comparative amounts of moisture in the air of different localities. The apparatus employed for the purpose was somewhat similar in form to the "ice calorimeter" of Lavoisier and Laplace. It consisted of a hollow metal cylinder lined inside with cork, open above, and terminated below by a cone. Ice was placed within it, and there was a lateral tube communicating with the interior for allowing the water produced by the liquefaction of the ice to flow away. The aqueous vapour in the atmosphere would obviously be condensed by the cold surface of the metal, and the water would trickle down the side of the cylinder, and finally drop from the apex of the cone; it was received in a graduated vessel. By noting the amounts of water collected in different localities in a given time, the comparative amounts of aqueous vapour in the air of those localities could be determined.

Under the title of "An experiment of Mr. Robervall's in favour of the air's pressure upon inferior bodies, tryed in our Academy," we have an account of a very ingenious experiment, performed by means of the following apparatus:—A is a glass tube, forty-six inches long, terminated above by a cup-shaped enlargement B, and dipping below into a vessel of mercury C. B is furnished with a glass cover D, the edges of which are accurately ground so as to form an air-tight connection with B. From D there projects a tube E. The cover D has an orifice in its upper part, through which passes air-tight a tube F, forty-six inches long, the lower end of which dips into a small vessel G, containing mercury, placed within B. Wet bladder is tied over the lower orifice of A. Mer-



¶ This work is in the form of a beautifully printed folio, with numerous full page plates of apparatus. It is entitled "Saggi di Naturali Esperienzo, fatto nell' Accademia del Cimento. E descritto del Segretario di essa Accademia. In Firenze, 1667." It was done into English in 1684 by Richard Waller, and printed by order of the Royal Society.

cury is now poured into the apparatus until it issues from E, which is then closed with wet bladder, and the pouring of the mercury continued until the tube F is full:—bladder is then tied over its orifice. The bladder is now removed from the lower orifice of A, when the mercury immediately leaves the tube F and the vessel B, and remains suspended in A at a height of thirty inches above the mercury in C; the small vessel G will obviously remain full of mercury. On removing the bladder from E the column of mercury in A immediately subsides, and mercury rises in F until it stands at H, a height of thirty inches above the surface of the mercury in the vessel G.

Many of the vacuum experiments described in the Proceedings of the Society were made in the Torricellian vacuum; but the air-pump was also used. Some of the experiments of this nature relate to the behaviour of birds and animals in rarefied air. Fishes were placed in a receiver, in a vessel of water; on exhausting, they swelled out considerably, turned over, and quickly died, when dissected the air-bladder was found to be empty. An eel lived for some time in vacuo, but was found to be dead at the end of an hour; the air-bladder, as in the case of the fish, was empty.

Pascal found that a bladder partially inflated at the level of the sea became wholly inflated on the summit of a mountain. Roberval made the same experiment with a carp's bladder, which burst when placed in the Torricellian vacuum. This suggested to some of the members of the Academy the idea that the expansion of air, "when at absolute liberty in any place," might be determined by annulling the atmospheric pressure by the weight of a column of mercury below the air, the expansion of which it is desired to determine. Accordingly, two similar tubes, open at one end, and terminated at the other by a bulb, were filled with mercury: one was inverted and opened under mercury in the usual way of performing Torricelli's experiment; into the other a small quantity of air was introduced before the tube was inverted; by calculation it was found that the air had expanded to 173 times its original bulk, but the experiments were not very concordant.

I may mention in passing that the experiment proving the incompressibility of water, by causing it to force its way through the pores of a metal, which is universally attributed to the Accademia del Cimento, was performed many years earlier by Bacon,** who used a sphere of lead for the purpose, while the academicians employed a sphere of gold.

In the next paper we shall consider the early labours of the Royal Society and of the Academie des Sciences relative to the subject under discussion.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Anniversary Meeting, Thursday, March 30.

Professor A. W. WILLIAMSON, *Ph.D., F.R.S., President, in the Chair.*

In an able address the President sketched the history of the Society's proceedings during the past year, referring to the satisfactory condition of its finances, and the gradually increasing number of its members. At the present time the Society was composed of 453 Fellows, 38 foreign Members, and 6 Associates. The papers read during the past year were enumerated, and their number amounted to 32. The success of the Journal had been considerably augmented by its more frequent publication, and by the more valuable nature of its contents. The Society had to deplore the loss by death of four members during the year; their names and qualifications were described by the President. The late Dr. Robert Dundas Thomson was well known as the Officer of Health for Marylebone,—a post which he held for several years with honour to himself and in the exercise of duties of undoubted usefulness. Mr. James Beaumont Neilson, F.R.S., of Castle Douglas, N.B., was the eminent inventor of the hot-blast, and of other improvements in the manufacture of iron. Dr. Alphonse Normandy was by birth a Frenchman, who, having studied and graduated abroad, ultimately adopted London as his place of residence. His works on analytical chemistry had contributed to his reputation, but his crowning effort was the invention of an apparatus for distilling and aërating water on board ship, which appeared to be now in general use in Her Majesty's navy. Dr. Thomas Pugh, late of the Agricultural College of Pennsylvania, U.S., was better known in this country in connection with the Rothamsted laboratory, where some years ago he made a valuable series of experiments, in conjunction with Mr. Lawes and Dr. Gilbert, on the assimilation of nitrogen by plants. Dr. Pugh's quantitative method of estimating nitric acid was known to be one of the most accurate and practically available of the processes described for this purpose. The Treasurer, Dr. Warren De la Rue, then presented his financial statement, and compared the state of the funds at this date, when the assets were 1889*l.* 18s. 11d., with the 150*l.* Consols and 150*l.* balance in the hands of the bankers, which represented the whole fortune of the Society at the time of his accepting office eight years ago. The increased receipts for 1864-5 enabled him to buy in 100*l.* Consols during the present year. The greatest items of expenditure were:—

Publication of the Society's Journal .	. 418*l.*
Proceedings of the Royal Society .	. 50*l.*
Purchase of books	. 36*l.*
Household expenses	. 48*l.*

The balance-sheet having been audited, was ordered to be suspended.

The TREASURER offered a suggestion which he hoped would diminish the difficulty of levying arrears. In estimating the losses a sum of 80*l.* had been written off for bad debts; and to meet these cases in future an alteration of the fourth bye-law was proposed, the practical effect of which would limit to two years, instead of three, the interval which must be allowed to elapse before the payment of arrears can be enforced or steps taken in default.

Dr. De la Rue's proposition having been put to the vote was carried unanimously.

The ballot was then taken for the election of officers for the year ensuing, and Dr. Attfield and Mr. Duppa were appointed scrutators. These gentlemen reported that the votes had carried the election of the under-mentioned officers:—

President—W. A. Miller, M.D., F.R.S.

Vice-Presidents, who have filled the office of President—W. T. Brande, F.R.S.; Sir B. C. Brodie, F.R.S.; C. G. B. Daubeny, M.D., F.R.S.; Thomas Graham, F.R.S.; A. W. Hofmann, Ph.D., LL.D., F.R.S.; Lyon Playfair, Ph.D., C.B., F.R.S.; A. W. Williamson, Ph.D., F.R.S.; Colonel Philip Yorke, F.R.S.

Vice-Presidents—Walter Crum, F.R.S.; Warren De la Rue, Ph.D., F.R.S.; John Stenhouse, LL.D., F.R.S.; Robert Warington, F.R.S.

Secretaries—William Odling, M.B., F.R.S.; Augustus Vernon Harcourt, Esq.

Foreign Secretary—E. Frankland, Ph D., F.R.S.

Treasurer—Theophilus Redwood, Ph.D.

Other Members of Council—F. A. Abel, F.R.S.; G. B. Buckton, F.R.S.; Dugald Campbell; H. Debus, Ph.D., F.R.S.; B. F. Duppa; G. C. Foster; E. A. Hadow; J. B. Lawes, F.R.S.; Hugo Müller, Ph.D.; W. J. Russell, Ph.D.; Maxwell Simpson, M.B., F.R.S.; C. Greville Williams, F.R.S.

** See "Novum Organum." Book 2. Aph. 45.

A vote of thanks to the retiring officers was proposed by Dr. A. W. **Hofmann**, seconded by Dr. **Frankland**, and, after a few complimentary words from Dr. **Bachhoffner**, carried unanimously. It was stated that the post of secretary had been held by Dr. Redwood during a period of fifteen years. The retiring **President** briefly acknowledged the expression of thanks and approbation, and then adjourned the meeting until 6th April.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, March 17, 1865.

On the Latest Discoveries concerning the Sun's Surface.

By Balfour Stewart, *F.R.S.*

Our moon, it is well known, is almost as correctly mapped as our own globe, so that an astronomer, could he be transported to the surface of our satellite, would arrive there prepared to expect a certain appearance; and on his arrival he would not probably be much surprised. But could such an one be transported to the surface of our luminary his case would be very different; for he would arrive there hardly knowing what to expect. He might not be sure in his own mind whether or not the luminous matter would prove to be composed of a number of distinct bodies, like willow-leaves, whether the spots would be found to be hollow in this luminous matter, or whether they would prove to be clouds floating above it. The cause of this uncertainty is twofold. First of all, it is due to the circumstance that a distant body such as the sun or moon does not impress us with the idea of relief. The disc of such a body appears quite flat, and the mountains of the moon are only distinguished from the valleys by a difference of shading. This absence of the idea of relief is due to the distance of these bodies.

If we hold a small cube of wood very near the eye, shut the right eye, and view the cube, then shut the left eye and do the same, evidently the cube presents a different appearance to each eye; and it is this difference that enables one, when both eyes are used, to obtain the idea of relief. But if this cube be a very great distance off it will appear nearly the same to both eyes, and the idea of relief will not be obtained. Thus, for example, a distant mountain does not stand out like the nearer parts of a landscape because our eyes are not far enough apart to give that difference of position which is necessary; and it has been well remarked by Sir J. Herschel that the moon would appear spherical and full of mountains to a giant whose eyes were thousands of miles apart, while to ordinary mortals it merely appears a flat disc. We can, however, by putting together two pictures of the moon or of the sun, taken at different times, produce a stereoscopic representation of these bodies. This has been done by Mr. De la Rue for the moon with great success, and also for the sun in less numerous instances.

The present knowledge which we possess of the surface of our luminary is not, therefore, derived from the idea of relief given naturally, and only to a certain extent from stereoscopic representations, but it is to a considerable extent derived from a careful study of sun pictures; and this leads to our second difficulty. Long before the invention of the stereoscope, it was known quite well what parts of the moon's surface were mountains and what hollows; for it was comparatively easy to argue regarding a set of phenomena which do not differ very greatly from those which belong to the surface of our earth; but the phenomena in our sun are so entirely different from any that we experience, and, perhaps, from any that we can conceive, that we must be exceedingly careful in our conclusions regarding them in order that we may not be misled. We must throw away all speculation and all hypothesis, and submit to be guided by observation alone. The luminous disc, or surface of the sun, which we see is termed its photosphere; and our whole inquiry may be divided, with reference to this bounding surface, into three parts, the first relating to the region above the photosphere, the second to the photosphere itself, and the third to the region below the photosphere.

To commence with the region above the photosphere, it is easy to show that it contains a very dense atmosphere, which is of a comparatively low temperature. In the first place, according to a well-known law, the dark lines in the solar spectrum denote the presence of certain substances in a state of vapour, and yet in a comparatively cold state above the photosphere of the sun. These substances comprise, among others, sodium, magnesium, iron, and nickel. Another proof of the existence of a solar atmosphere is that the light, more especially the actinic light, from the border is less intense than that from the centre of the disc; this is due to the fact that light from the border has to pierce through a much greater depth of atmosphere than light from the centre, and hence a great portion of the light from the border will be absorbed by this atmosphere if it be colder than the source of light. (This was exhibited by means of a photograph of Mr. De la Rue's.) The last proof of an atmosphere is that derived from the picture of the sun taken during a total eclipse.

When the sun is totally eclipsed there is not yet total darkness. There is, in the first place, a glory or corona round his disc, and in the second there are curiously-shaped bright bodies round him called red flames, and sometimes red protuberances. It appeared to the Astronomer Royal and some others that it was probable that these bodies belong to the sun, but the thing was put beyond doubt by Mr. De la Rue, who, by means of the Kew heliograph, was enabled to take photographic pictures of the sun at the total eclipse which happened in Spain in July, 1860.

These photographs (which were exhibited) showed that as the moon proceeded over the sun's disc the red flames and part of the corona discovered themselves at that side which she had left, and were covered up by her disc at that side towards which she was approaching; thus showing that they belonged to the sun. Another proof in favour of these bodies belonging to the sun is derived from the nature of the light which they emit. This light was found to have great photographic power compared to its luminosity; so much so, that one prominence was photographed by Mr. De la Rue that was invisible to the naked eye. Now such rays, as far as we know, can only belong to intensely heated gas, and intensely heated gas can only belong to the sun. Next, with regard to the photosphere, the first thing to be noticed is the fact that this surface is not a smooth, uniform, continuous surface. When it is viewed through powerful glasses it appears granulated or mottled. (Reference was made to a large diagram kindly lent by the Rev. F. Howlett.) But this is not all; there is reason to believe that great magnifying and defining power shows us something more, although it is very difficult to see it. Mr. James Nasmyth was the first to proclaim the curious fact that the whole photosphere of the sun is made up of detached bodies interlacing one another, and preserving a great amount of regularity both in form and size; he called them willow-leaves, Mr. Stone has called them rice-grains, Father Secchi coups-de-pinceau. (Here some pictures taken by Mr. Nasmyth were exhibited.) It would be a speculation much beyond our power to conjecture what it is that gives these bodies the astonishing regularity of form.

In connection with this part of the subject, attention should be directed to the brighter portions of the photosphere, or faculæ as they are sometimes called. It is chiefly near the limb of the sun that these relatively bright portions of the sun's disc appear; for when they come to the centre the difference in brightness between them and the surrounding parts of the disc is not so easily traced. Now, the reason of their great brightness is believed to be this—they are portions of the sun's photosphere thrown up into the higher regions of the atmosphere. This enables them to escape a great portion of the absorbing effect by this atmosphere, which, as has been shown, is particularly strong near the border; and hence when there they appear much brighter than the surface around them; but near the centre the absorption is not great, so that they do not *gain much* by escaping it. The idea that these faculæ are elevations has been confirmed by a stereoscopic impression of a sun spot and some faculæ taken by Mr. De la Rue, and in which, while the spot appears to be a hollow, the faculæ appear as elevated ridges. It thus appears that the faculæ are elevated; but further they retain the same appearance often for a considerable time, sometimes even for days together; so that faculæ are not composed of heavy matter, otherwise they could not remain elevated; and hence the faculæ as well as the photosphere, of which they are only the most elevated parts, is not composed of heavy matter such as a molten sea, but is rather of the nature of a cloud.

The phenomena of the third region or that below the photosphere may be comprehended in one word—sun spots. These consist of an umbra or central darkness, surrounded by a less dark penumbra. Mr. Dawes has discovered in some spots even a deeper darkness in the centre of the umbra. Now, if it be correct to suppose that spots are cavities, of which the umbra forms the bottom and the penumbra the sloping sides, then the umbra ought to encroach on that side of the penumbra which is next the visual centre of the disc. Professor Wilson, of Glasgow, was the first to remark that spots really behaved in this manner; and his remark has been abundantly confirmed by the Kew photographs taken under the superintendence of Mr. De la Rue. (One of these was exhibited, showing the phenomenon.) It, therefore, follows that the umbra of a spot is at a lower level than the penumbra; and since luminous ridges and sometimes detached portions of luminous matter cross over spots, it must be concluded that the whole phenomenon is below the surface.

Again, spots exhibit the rotation of our luminary. If we turn to the south and view the sun, spots always cross the disc from east to west—that is to say, from left to right. (The apparent path of a spot at different seasons was here traced on a diagram lent by the Rev. F. Howlett, and it was remarked that when allowance is made for the inclination of the earth's axis the path is really the same at different seasons.) Besides the apparent motion, due to rotation of the sun, spots have also a proper motion of their own, first observed by Mr. Carrington; this motion is also from left to right, those near the solar equator moving fastest. Mr. Carrington also remarked that spots confine themselves to the equatorial regions of the sun.

Hofrath Schwabe, of Dessau, has remarked that spots have a period of maximum and minimum nearly every ten years, and General Sabine has found that the year of maximum sun spots is at the same time that of greatest disturbance of the earth's magnetism.

Finally the behaviour of sun spots appears to some extent to be influenced by the planet Venus in such a manner that when a spot comes round by rotation to the ecliptical neighbourhood of this planet it has a tendency to dissolve, and, on the other hand, as the sun's surface recedes from this planet it has a tendency to break out into spots.

ACADEMY OF SCIENCES.

March 27, 1865.

M. C. St. Claire Deville read the first part of his memoir "*On the Probable Influence of the Appearance of Asteroids on the Temperature of the Air.*" The author at starting quoted the opinions of other astronomers and meteorologists who have shown that at the periods when asteroids are most numerous, notable perturbations in the temperature at the surface of our globe occur. From a review of the observations made in Paris during the fifty-seven years 1806-1863, M. Deville showed a diminution of temperature occurred from the 10th to the 15th of February, and from the 10th to the 16th of May. From the 11th to the 15th of August there would, on the contrary, appear to be a slight elevation of temperature. On the days of the maximum appearance of asteroids in November, 13th to 16th, the influence is less clear. There would seem to be a decrease at first, and subsequently an elevation. The observations detailed in the paper are of the greatest interest to meteorologists, and will, no doubt, attract great attention. We may quote one paragraph which shows the fallacy of calculating averages from insufficient data. The mean temperature of February 1 in Paris, deduced from the observations of the ten years 1829-1839, is 1·43; calculated from observations in the ten years 1843-1853 it will be 5·30.

A note by M. P. Gervais, "*On the Application of the Electric Light for Illumination under Water,*" suggests the use of a battery and coil in a water-tight box, and a Geissler's carbonic acid tube. Rhumkorff has made the author such an apparatus, which has been quite successful. It acted well under water for six hours.

M. Cahours presented a long note "*On Organic Radicals,*" in which he described some new compounds of sulphur and tellurium with ethyl and methyl, the means by which they were obtained, and their general properties.

M. Gaultier de Claubry presented a note "*On New Solvents for Aniline Colours.*" The author experimented to find cheap substitutes for alcohol and wood spirit, and discovered that a decoction of soap bark, or of Egyptian soap root, will dissolve the colours and yield solutions very convenient for dyeing and printing. One advantage of these solutions, it seems, is that they give uniform shades.

M. Hoffmann sent from Giessen a note "*On the Vegetable Nature of Yeast,*" which we believe was satisfactorily decided before M. Hoffmann began his experiments.

NOTICES OF BOOKS.

The Retrospect of Medicine; being a Half-Yearly Journal containing a Retrospective View of every Discovery and Practical Improvement in the Medical Sciences. Edited by W. Braithwaite, M.D., and James Braithwaite, M.D. Vol. L.—July to December, 1864. London: Simpkin, Marshall, and Co. 1865.

We need only announce the title of this book, so useful to medical practitioners, and say that the present volume worthily sustains the character of its predecessors.

Stammering and Stuttering: their Nature and Treatment. By James Hunt, Ph.D., &c., &c. Sixth Edition. London: Longman and Co. 1865.

We hardly know why this book is sent to us. Chemists do not usually stutter. It would be very awkward if they did, seeing they have at times to get out such words as *methylethylamylophenylium*. If, however, any one should find a difficulty in enunciating this polysyllabic monstrosity, we have no doubt he might advantageously put himself for a time under Dr. Hunt's treatment, which, to our own knowledge, is very successful in removing impediments of speech.

Bulletin de la Société de Chimique de Paris. March, 1865.

The proceedings of the Chemical Society of Paris at the two sittings here reported, offer very little of interest, most of the papers, as usual, having already been noticed in the proceedings of the Academy of Sciences. We give in another place a note by M. Gal on the action of sodium on carbonic ether, and a new process for the preparation of benzoic acid by MM. P. and E. Depouilly. We have given some account of the latter paper before; but as the subject is of some commercial as well as scientific importance, we shall give the entire paper.

The abstracts from foreign journals in this number of the *Bulletin* are, as usual, numerous and complete.

Chemisches Central Blatt. Nos. 8, 9, 10.

NUMBER 8 contains an article by M. Alsberg "*On Acetals*," in which the author shows that by heating the aldehyd with several volumes of an alcohol bodies homologous with acetals may be obtained. The author has in this way formed diamylacetal, dimethylacetal, diethylrateral, dimethylerateral, &c. There is also a paper by Reichardt "*On a New Mode of Obtaining Monohydrated Oxalic Acid.*" The author dissolves the ordinary acid in concentrated sulphuric acid, from which solution, after a time, the monohydrate crystallises out. The first crystals which form are the ordinary terhydrate; then a bihydrate separates; and, lastly, after a week, small rhombic octohedral crystals of C_2O_3,HO deposit. They quickly attract moisture, and must be isolated and dried with great care. The abstract of a paper by Brande "*On the Chemical Composition of Tobacco Leaves*" announces the presence in them of malic, citric, and oxalic acids. A short notice of a process for preparing chloride of platinum we transfer to our pages in another place, as well as a method of removing empyreumatic oils from acetic acid by Frederking.

Numbers 9 and 10 contain an original communication from Dr. Heiden, entitled "*A Contribution towards Explaining the Cause of Absorption by Soils.*" The principal agents concerned in the fixation of alkalies in the soil are, according to the author, hydrated silicates; but we shall give the whole of his conclusions in an early number. In Number 9 we have also an announcement by Professor Reichardt "*Of the Formation of Oxalic Acid by the Action of Oxide of Copper on Milk Sugar in the Presence of Free Alkalies.*" To effect this reduction, the use of a relatively large proportion of copper salt is necessary. With one part of milk sugar and six parts of acetate of copper, the author obtained 8·1 per cent. of oxalic acid. By some "*Chemical Researches on Red Coral,*" Shaper has shown that the colour of red coral is entirely owing to the presence of anhydrous peroxide of iron. Benzol, ether, &c., extract a yellow resinous substance without changing the colour of the coral. Brandl and Rakowiecki have made an *analysis of beechnuts*, in which they find 45 per cent. of a fatty oil, a caseine-like substance, resin, starch (3 per cent.), gum, sugar, citric and oxalic acids, tannin, and an infinitesimal quantity of a volatile alkaloid —trimethylamine.

NOTICES OF PATENTS.

1540. *Dyeing and Printing.* C. A. MARTINS, Warrington. Dated June 21, 1864.

THE patentee produces black, brown, and drab colours upon linen and calico by padding or printing upon these fabrics with a salt of phenylenediamine, and afterwards exposing the moist surfaces to the action of ammonia. The tint of colour produced can be modified by varying the strength of the solutions, and by using mixtures of phenylenediamine with any of its homologues.

1545. *Apparatus for Manufacturing Sulphate of Ammonia and Sulphuric Acid.* J. FORBES, Old Ford, Bow. Dated June 21, 1864.

IN the production of sulphate of ammonia by saturating dilute sulphuric acid with gas-tar liquor it is well known that much sulphuretted hydrogen is evolved; in order to get rid of this objectionable product and economise the sulphur which it contains, the fumes are burnt, and the sulphurous acid formed is conducted into leaden chambers for the purpose of being converted into sulphuric acid.

1538. *Obtaining Sulphuric Acid from the Refuse Pickle used in Tinplate Works, and also from the Sulphate of Iron or Green Copperas.* W. J. PUGHSLEY, Christchurch, Monmouthshire. Dated June 21, 1864.

THE method of treatment specified by the inventor consists in evaporating down the refuse liquid and allowing the green vitriol for the most part to crystallise out; the excess of sulphuric acid always present in the mother liquor may then be economised by employing it in its more concentrated form for the cleaning of fresh iron surfaces, whilst the crystals of green vitriol are submitted to distillation in retorts for the purpose of furnishing sulphuric acid according to a well-known principle on which the Nordhaussen acid is usually manufactured.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by MR. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

549. W. Sim, Glasgow, N.B., "An improved method of extracting gases from mineral oils, and in employing the same for illuminating and heat producing purposes, and in the machinery or apparatus connected therewith." —Petition recorded Feb. 27, 1865.

590. W. E. Newton, Chancery Lane, "An improved process and apparatus for impregnating wood with chemical solutions."—A communication from E. Bazin and J. Hémery, Paris.—March 2, 1865.

606. J. H. Johnson, Lincoln's Inn Fields, "Improvements in stopping bottles."—A communication from N. B. Goodyear, New Haven, Conn., U.S.A.—March 4, 1865.

624. F. Cruickshank, Edinburgh, N.B., "Improvements in coatings for the prevention of the fouling to which iron and other ships and structures are ordinarily liable in sea water."

630. G. Nimmo, Jersey City, N.I., U.S.A., "Improvements in the manufacture of crucibles and pots in which metals or other substances may be melted."—March 6, 1865.

646. G. Ireland, Handsworth, Staffordshire, "Improvements in stoppers for closing bottles, and for other like purposes."—March 8, 1865.

478. J. Cliff, Wortley, near Leeds, "An improvement in the utilization of the waste gases of blast furnaces."—Feb. 20, 1865.

591. C. Rahn, Brook Street, Grosvenor Square, "An improved instrument for concentrating light, applicable to dental, surgical, and other operations."—March 2, 1865.

599. R. A. Brooman, Fleet Street, London, "Improvements in refining sugar and in apparatus employed therein." A communication from A. Guillon, Nantes, France.—March 3, 1865.

617. A. Akeroyd, Bradford, Yorkshire, "An improved process and apparatus for dyeing and preparing cotton, worsted, and silk warps."—March 4, 1865.

631. W. Clark, Chancery Lane, "Improvements in preparing or treating hides for tanning." A communication from W. Martz, Boulevart Saint Martin, Paris.—March 6, 1865.

636. L. Perkins, Francis Street, Gray's Inn Road, "Improvements in apparatus for heating and cooling atmospheric air and other aëriform bodies, and for heating ovens, and for heating and ventilating buildings."—March 7, 1865.

645. A. C. Henderson, Charing Cross, "An improved method of preserving meat." A communication from H. F. Méressart, Paris.

649. M. Morgans, Brendon Hills, Somersetshire, "Im-

provements in converting cast-iron or pig iron into wrought iron or steel, and in machinery employed therein."—March 8, 1865.

657. R. Mushet, Cheltenham, Gloucestershire, "Improvements in the manufacture of steel and homogeneous iron."

666. J. Cliff, Wortley, near Leeds, "An improvement in the construction of hot-air stoves for blast furnaces."

668. G. F. Ansell, Bernard Street, Russell Square, "An improved mode of, and apparatus for, ascertaining and indicating the presence of explosive gases."—March 9, 1865.

692. E. B. Wilson, Glasgow, N.B., "Improvements in furnaces and fire-places."—March 11, 1865.

700. J. Wright, Dudley, Worcestershire, "Improvements in puddling, heating, and other furnaces."—March 13, 1865.

717. G. T. Bousfield, Loughborough Park, Brixton, Surrey, "Improvements in apparatus for vaporising hydrocarbon liquids for illuminating and heating."—A communication from J. Griffen, Meridan, Conn., U.S.A.

719. A. V. Newton, Chancery Lane, "Improvements in securing low and uniform temperatures, applicable to public and private buildings, also to refrigerators, coolers, and condensers, and to ships and other vessels, and in the apparatus employed therein."—A communication from D. Somes, Washington, U.S.A.—March 14, 1865.

730. J. F. Brinjes, Fieldgate Street, Whitechapel, "Improvements in apparatus for cooling animal and other charcoal."

732. C. Morfit, Avenue de l'Imperatrice, Paris, "Improvements in heating and purifying oils and fats."—March 15, 1865.

765. J. C. Stevenson, South Shields, "Improvements in the preparation of hyposulphite of lime."—March 18, 1865.

777. R. T. Crawshay, and J. A. Lewis, Cyfarthfa Iron Works, Glamorganshire, "Improvements in the manufacture of puddled iron bars and every description of malleable iron."—March 20, 1865.

805. J. Wright, St. Paul's Crescent, "Improvements in the process of preparing Kaolin or China clay and other clays for potters' use, and for expelling water from other earthy deposits." A communication from J. Muir, New York, U.S.A.—March 22, 1865.

Notices to Proceed.

2852. A. Wall, Clapton, "An improved combination or improved combinations of materials to be used as fuel."—Petition recorded Nov. 15, 1864.

2883. A. A. Croll, Coleman Street, London, "Improvements in the preparation of materials to be used in the purification of gas for illumination."—Nov. 18, 1864.

2910. G. M. de Bayelt and J. E. Vigoulète, Nelson Square, Surrey, "An improved method of compounding, by agglomeration, artificial fuel."—Nov. 23, 1864.

2969. M. A. F. Menuous, Westminster, "Improvements in hot blast furnaces." A communication from N. de Telescheff Ofitzerkaïa, St. Petersburg.—Nov. 29, 1864.

630. G. Nimmo, Jersey, U.S.A, "Improvements in the manufacture of crucibles and pots in which metals or other substances may be melted."—March 6, 1865.

Metropolitan Sewage.—A committee of the House of Commons has reported in favour of the scheme of Messrs. Hope and Napier,—a scheme which has always appeared to us, in spite of the protestations of Baron Liebig, to offer the most reasonable prospect of the profitable disposal of the sewage. We have said before also that Mr. Ellis's plan might have a trial simultaneously if capitalists will come forward with the necessary money. The sewage of one district would be quite sufficient for an experiment.

CORRESPONDENCE.

Continental Science.

Paris, April 3.

My letter last week was unavoidably curtailed, or I intended to give an account of some applications of liquid ammonia by M. Tellier, of whose ammoniacal horses I have before spoken. These applications are founded upon two indisputable truths:—1. In empty spaces liquids spontaneously give off vapour, the tension of which immediately reaches its maximum. 2. In two spaces communicating, kept at unequal temperatures, and containing one liquid, there is always evaporation in the warmer space and condensation in the colder. The first application suggested is a means of cooling the air of the saloon and cabins of a steamer, say going down the Red Sea, where the want of cool air is generally experienced. For this purpose he puts liquid ammonia in a sort of tubular boiler, the tubes of which are in free communication with the air and the saloon to be cooled, while the boiler itself is in communication with a worm and receiver bathed with a stream of cold water. The warm air as it passes through the tubes parts with its caloric to vaporise the ammonia, and so reaches the cabin delightfully cool, while the ammonia goes on to the receiver to be again condensed. On its way it is utilised to drive a ventilator, supply cold water to the receiver, and pump itself back again to the generator; but by what contrivances and machinery is not stated. A modification of the same plan, as M. Tellier states, is also adapted to cool theatres and other places of entertainment, as well as ships' cabins. More ingenious still is the idea of making the solar rays volatilise ammonia, and so in parching heats manœuvre a pump or pumps which shall irrigate the thirsty earth with refreshing streams, and so make the sun partially undo its own work. More practicable, perhaps, is the idea of using the liquid ammonia to cool the wort in breweries and maintain a constant temperature during fermentation. Remember that all these ends are to be effected without loss of material, and give M. Tellier the credit of being one of the greatest inventors or most ingenious theorists of modern times.

M. Maistre, I may tell you, has published here suggestions for an alarum thermometer, closely resembling, I believe, one imagined by your correspondent, Mr. Wentworth Scott. It is to be connected with magnetic apparatus which is to open and shut ventilators, and regulate the temperature of an apartment without the intervention of human agency. The contrivances for this are very easily imagined, but have never, that I remember, been put in practice.

A Portuguese naval officer with a long name, one José de Menna Apparicio, has proposed a new constant battery for telegraphic purposes. It is a modification of those of Marie-Davy, and Minotto. The electrodes are zinc and carbon, but in place of sulphate of copper the author uses sulphate of mercury. A cylinder of carbon is fixed in a disk of the same substance, which rests upon and is covered by a layer of the sulphate at the bottom of the cell. To give a large extent of surface zinc bands are twisted in the form of a spiral. The cell is filled up with moist sand. An electrician will easily see how the connections are established. The author says the battery is both cheap and constant.

I see a way of preserving potatoes described which may be useful to some of your readers. At the bottom of a dry floor a few inches of straw is laid, upon this a layer of potatoes 12 or 15 centimetres deep is placed, which is dusted over with plaster of Paris; more straw is then put, and again a layer of potatoes, and so on for eight or ten layers. When preserved in this way it is said the tubers never sprout.

The decimal system would seem to be spreading here. Few people will use decimal weights in ordinary commerce if they can help it, and only use a decimal coinage because they have no other. Nevertheless, M. Cacheleux has brought out a decimal time piece and watch. He divides the day into ten hours, the hours into 100 minutes, the minutes into 100 seconds, and these last into 100 *thirds*. The dials are marked with the ordinary divisions as well, so people may consult which style they please. No doubt astronomical and nautical calculations might be simplified by the change suggested, which a married lady tells me is further recommended by the circumstance that if it were once adopted nobody could ever again stay away from home so late as twelve o'clock.

A very ingenious direct vision spectroscope has been devised by M. Hoffmann, the optician here. The pocket instrument is a straight tube containing five prisms so arranged that the rays pass in and out in a straight line, and the objective is placed between the prisms and the slit.

Professor Wanklyn's Paper on Vapour Densities.

To the Editor of the Chemical News.

Sir,—From the letter which Professor Wanklyn addressed to you last week, I perceive that the author is not well satisfied with the report or abstract of his communication which appeared in the Chemical News of 24th March. My duty as reporter was an easy one; for having in this instance the advantage of comparing my notes with the original manuscript, and finding, moreover, the greater part of the author's statement already in print as an earlier communication to the Society, I am not prepared to admit the force of Professor Wanklyn's objection.

Your readers will in due course have an opportunity of comparing the author's original with my transcript; unless, indeed, the want of novelty in the said communication should stand in the way of its appearing once more in the Annals of the Society. I am, &c.,

The Reporter.

April 3.

MISCELLANEOUS.

The Chemists' and Druggists' Bills.—These two bills have, as we expected, been referred to a select committee of the House of Commons. In the debate on the second reading, Sir George Grey advocated the course we have recommended,—namely, a fusion of the two bills. He contended that the retail trade in medicines needed supervision, and urged the necessity of some provision respecting the sale of poisons.

Public Schools' Bill.—We are sorry to see that this extremely mild but promising measure has been referred to a Select Committee of the House of Lords. The simple proposal to place men eminent in science on the governing boards of such institutions as Eton, Harrow, and Rugby Schools appears to have been sufficient to excite the opposition of a man so liberally inclined as Dr. Temple. There would seem to be little hope of establishing in these institutions a system of education adapted to the nineteenth century.

Royal Institution.—This evening, Friday, April 7, Dr. A. W. Hofmann, F.R.S., "On the Combining Power of the Atoms of the Elements."

Preparation of Chloride of Platinum.—Böttger first fuses platinum with three times its weight of lead, powders the alloy, and then digests in nitric acid to remove the greater part of the lead. He then dissolves the residue in aqua regia, evaporates to dryness, dissolves in water, filters, and decomposes the filtrate with a slight excess of carbonate of soda, whereby he precipitates the remaining lead, and obtains a platino-chloride of sodium, which can be used at once to precipitate rubidium, cæsium, thallium, &c. To recover the platinum from the washings, he boils these with a large excess of carbonate of soda and some glucose until the mixture blackens. By supersaturating now with dilute sulphuric acid, and heating for a time, the platinum quickly separates quite pure.

Ozone and Antozone.—We have endeavoured in vain to find a confirmation of the statement that Schönbein had succeeded in isolating the opposite conditions of oxygen. The last published volume of the Proceedings of the Royal Academy of Munich, to which we were referred, contains no paper by Schönbein. We doubted the truth of the intelligence when we announced it, for it would have been strange if the news of such a discovery had not spread over Europe with the speed of lightning.

Removal of Empyreumatic Oils from Pyroligneous Acid.—Frederking, treats two gallons of acetic acid with nine drachms of bichromate of potash and three drachms of sulphuric acid, allows the mixture to stand twenty-four hours in the cold, and then distils off the acid to within a few ounces.

Dalton's Thermometer.—At a recent meeting of the Manchester Literary and Philosophical Society, Mr. Baxendell stated that the Society had in its possession a thermometer constructed by the late Dr. Dalton, and which, it is believed, was used by him in many of his meteorological observations. The scale had the initials "J. D." and the year "1823" engraved upon it; and the freezing and boiling points of water are indicated on the stem by fine file marks. As it is known that the zero points of thermometers sometimes change to the extent of one or even two degrees in the course of several years, it occurred to Mr. Baxendell that it would be interesting to ascertain whether any change had taken place in this thermometer, and he had therefore lately tested very carefully the position of the freezing point, but found that no sensible alteration had taken place; and he believed therefore that great confidence might be placed in the observations which Dalton had made with this instrument.

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the Editor and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. *Private* letters for the Editor must be so marked.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. X. of the Chemical News, containing a copious Index, is now ready, price 11s. 0d., by post, 11s. 6d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I and II. are out of print. All the others are kept in stock. Vol. XI. commenced on January 6, 1865, and will be complete in 26 numbers.

J. J., Jun.—The experiment suggested has been made.

W. V. R. (Leamington).—Such communications are always acceptable.

Juvenis.—You should use a dilute acid. One part to three of water is sufficiently strong.

X.—The best red sealing wax dissolved in spirit.

Inquirer must consult the records of the Patent Office. Several patents have been taken out for similar processes.

Calor.—An abstract of the papers will appear shortly.

A. C.—Arrangements are being made for them.

C. E. Goessman.—Letter received, but not pamphlet. All the corrections marked on the last copy were attended to.

F. H.—We forgot to mention last week that an account of Holmes' magneto-electric apparatus will be found in No. 15, Vol. 1, of the Chemical News.

Received with thanks.—R. Campbell, Montreal, Canada; A. H. Church; John Newlands, F.C.S.

Books Received.—"The Applications of Geology to the Arts and Manufactures," by Professor D. T. Ansted, M.A., F.R.S.

Erratum.—No. 278, page 156, second col., line 36, *for* "blue oxide," *read* "black oxide."

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

An Introduction to Chemical Philosophy, according to the Modern Theories, by ADOLPHE WURTZ, *F.R.S.*

PART I.

EQUIVALENTS, ATOMIC WEIGHTS AND MOLECULAR WEIGHTS.

SECTION II.—*New System of Atomic Weights.*

(Continued from page 159.)

LET us examine these points further.

I. The molecular weights of all these bodies are comparable with that of hydrogen, which is 2. The molecule of hydrogen is, therefore, formed of two atoms, and it is the same with the molecules of chlorine, bromine, iodine, oxygen, sulphur, and nitrogen. Each of these bodies in the free state consists of combinations of one atom with another atom of the same kind; their molecular formulæ are—

$$H_2 \quad Cl_2 \quad Br_2 \quad I_2 \quad O_2 \quad S_2 \quad N_2.$$

This is a development of the hypothesis which Ampère and Dumas applied to hydrogen and chlorine, and which is based upon an ingenious interpretation of the reaction by which these two elements combine to form hydrochloric acid. We have already described this hypothesis (page 122), which was adopted and developed by Gerhardt, and as it is of great importance, it is necessary to strengthen it by other considerations, drawn from the domain of pure chemistry.

Some chemists refuse to admit that a body may combine with itself; that pure hydrogen in the free state may be a hydride of hydrogen. Nothing is, however, more in harmony with certain reactions, of which this hypothesis alone is able to give a satisfactory explanation. Let us first take the case of hydrogen. In 1843 I discovered a combination of this body with copper—a combination which gives, with hydrochloric acid, a curious reaction; cuprous chloride being formed, whilst there is a tumultuous disengagement of hydrogen. But it is known that hydrochloric acid is not decomposed by copper; how, then, can it be by a combination of copper with hydrogen, unless the affinity of copper for chlorine were not supplemented by the affinity of hydrogen for hydrogen? Thus regarded, this reaction becomes a double decomposition of remarkable simplicity:

$$\underset{\substack{\text{Hydride of}\\\text{copper.}}}{HCu^*} + \underset{\substack{\text{Chloride}\\\text{of}\\\text{hydrogen.}}}{HCl} = \underset{\substack{\text{Cuprous}\\\text{chloride.}}}{CuCl} + \underset{\substack{\text{Hydride}\\\text{of}\\\text{hydrogen.}}}{HH}$$

On the other hand, this reaction is inexplicable if free hydrogen is considered as formed of a single atom. In fact, if copper by itself is incapable of decomposing hydrochloric acid, this would be still more the case with hydride of copper; for, in the former case, in order to decompose the hydrochloric acid, there would be only one affinity to conquer—that of chlorine for hydrogen: whilst in the second case there are two; for to this first affinity must be added that of copper for hydrogen, and however small this latter may be, it must be considered as a new obstacle. In a word, if copper does not decompose hydrochloric acid, hydride of copper should still less decompose it.

But, it may be said, the hypothesis of the duality of the molecule of hydrogen is insufficient to explain the difference between the two reactions in question; for if hydrogen, in order to be disengaged in the free state, requires to combine with itself, why is not this affinity of hydrogen for hydrogen exerted in the case of hydrochloric acid? It would only require that two molecules of hydrochloric acid should act upon the copper:—

$$Cu_2 + 2HCl = Cu_2Cl_2 + HH.$$

Such is the objection; it is removed by taking into consideration the polarity of elements—a subject first brought forward by Mr. Brodie,† and to which M. Schönbein has devoted great attention of late years.

The hydrogen in hydride of copper shows so great a tendency to unite with the hydrogen of the hydrochloric acid, because it finds itself in these two combinations in a state of opposite polarity. The hydrogen of the hydrochloric acid is positive in respect to the hydrogen of the hydride of copper.

$$Cu\overset{-}{H} + \overset{+}{H}Cl = \overset{-}{H}\overset{+}{H} + CuCl.$$

Analogous considerations apply to the molecule of free oxygen. There are reactions which can only be explained by admitting the duality of this molecule, formed like that of hydrogen, of two atoms. And these reactions have for their object, 1, the decomposition of the molecule of oxygen, and 2, the reconstruction of the molecule of oxygen.

1. It is known that oxygen and nitrogen combine with difficulty under the influence of the electric spark; but according to an old observation of Cavendish, confirmed by Lavoisier and Berzelius, the combination of these two bodies is easily effected in the presence of hydrogen. Thus, a notable quantity of nitric acid is formed when a mixture of hydrogen and nitrogen is burnt in oxygen. Here, I think, is the interpretation of this fact.

The molecule OO being attacked by hydrogen, one atom of oxygen, O, combines with H_2, whilst the other atom of oxygen, which may be considered in the nascent state, combines with the nitrogen.

M. Schönbein‡ has recently discovered the important fact that the oxidation of certain metals occasions the formation of small quantities of oxygenated water. Here again we must admit that there is a decomposition of the molecule of oxygen, and that one atom of oxygen in the nascent state fixes itself upon the water to form oxygenated water—

$$\underset{\text{Oxygen.}}{OO} + Cu + H_2O = CuO + \underset{\substack{\text{Oxygenated}\\\text{Water.}}}{H_2OO}.$$

2. On the other hand, some remarkable reductions are known to be effected by oxygenated water. Thénard showed that oxide of silver was reduced by this singular agent. Mr. Brodie, and long after him M. Schönbein, have discovered a great number of analogous reactions in which bodies saturated with oxygen are seen to reduce oxygenated water, and to be themselves reduced by it. Thus, when oxygenated water is added to a solution of permanganate of potash, a tumultuous disengagement of oxygen is observed, with the precipitation of brown hydrated manganic oxide. Oxygenated water is at the same time decomposed. A more curious reduction, perhaps, is that of ozone by oxygenated water. These facts may be interpreted by the following equations:—

$$\underset{\substack{\text{Oxide}\\\text{of silver.}}}{Ag_2\ominus} + \underset{\substack{\text{Oxygenated}\\\text{Water.}}}{(H_2O\oplus)} = Ag_2 + \underset{\text{Water.}}{H_2O} + \underset{\substack{\text{Free}\\\text{Oxygen.}}}{\ominus\oplus}.$$

$$\underset{\substack{\text{Permanganate}\\\text{of potash.}}}{MnKO_2\ominus_2} + 2\underset{\substack{\text{Oxygenated}\\\text{water.}}}{(H_2O\oplus)} \quad \underset{\substack{\text{Hydrated}\\\text{manganic}\\\text{oxide.}}}{MnHO_2} + \underset{\text{Potash.}}{KHO} + H_2O + 2\underset{\substack{\text{Free}\\\text{oxygen.}}}{\ominus\oplus}.$$

$$\underset{\substack{\text{Oxygenated}\\\text{water.}}}{(H_2O\oplus)} + \underset{\text{Ozone.}}{O_2\ominus} = \underset{\substack{\text{Free}\\\text{oxygen.}}}{\oplus\ominus} + O_2 + H_2O.$$

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* Cu = 63·5.

† *Philosophical Transactions*, 1850, part ii., p. 759.

‡ *Annales de Chimie et de Physique*, 3rd series, v. lix., p 103.

These latter reactions are particularly significant, for it cannot be comprehended how a body saturated with oxygen can reduce another in the same condition, unless the oxygen of the one possessed a certain affinity for the oxygen of the other.

M. Schönbein considers that oxygen is a combination of negative and positive oxygen; so far his opinion is strengthened by the observations just mentioned, but when he supposes that negative oxygen ⊖ constitutes in the free state ozone, and that positive oxygen ⊕ in the free state constitutes the body which he names antozone, he advances a hypothesis ingenious but gratuitous, for he has given no explanation of it. He has rather put himself in opposition to known facts. Messrs. Andrews and Tate have indeed demonstrated that ozone is condensed oxygen§ and the most rational interpretation of their experiments is to admit with Dr. Odling‖ that ozone consists of oxygenated water, H_2O_2, in which the hydrogen is replaced by an equivalent quantity of oxygen. The recent experiments of M. Soret¶ seem to confirm this manner of viewing it.

But to return to molecular weight. The arguments which have just been discussed appear to me to strengthen this important proposition, that two atoms of certain simple bodies can combine with each other to form one molecule. Here is another argument which strengthens this hypothesis, drawn from another order of facts. It is known that the radicals of organic chemistry may be considered in certain respects as the analogues of the elements in mineral chemistry. What, then, will happen when, in iodide of ethyl, the iodine is separated from the radical ethyl C_2H_5? This will combine with itself to form what has been named free ethyl,

$$C_2H_5 + C_2H_5 = C_4H_{10}.$$

Let us recall here that MM. Favre and Silbermann, in their classical researches on the heat evolved in chemical combination, were the first to suggest that the molecule of free oxygen is formed of two atoms.** On the other hand, it is known that M. Clausius has been led by mechanical considerations on the constitution of gases to admit "that the force which governs chemical combinations, and which probably consists of a kind of polarity of the atoms, exerts itself even between simple bodies, and that in these latter several atoms may combine into one molecule."

The most simple case, and consequently the one most likely to be true, says he, will be that in which two atoms form one molecule. Thus, in the case of oxygen or nitrogen, it may be imagined that the chemical force which resides in one atom is exerted on a second atom in a molecule of these gases.††

(To be continued.)

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§ *Annales de Chimie et de Physique*, 3rd series, vol. lii., p. 333, and vol. lxii., p. 101.

‖ "A Manual of Chemistry," by W. Odling. 1861. p. 94.

¶ "On the Volumetric Relations of Ozone."—*Bibliothéque Universelle et Revue Suisse*, vol. xviii., September, 1863.

** *Comptes Rendus*, xxiii., 200, 1846, MM. Favre and Silbermann have proved that carbon when burnt in protoxide of nitrogen evolves more heat than when burnt in oxygen. According to them the most natural interpretation of this fact consists in admitting that, in each experiment, a chemical combination is destroyed whilst another is formed; and that the thermic effect produced is the difference between the amount of heat disengaged by the union of carbon with oxygen and the amount of heat absorbed by the decomposition of oxide of oxygen in the first instance, and of oxide of nitrogen in the second. And if the thermic effect is less for oxygen than with protoxide of nitrogen, that is due to the circumstance that oxide of oxygen (the molecule of oxygen OO) absorbs more heat in decomposing than does the molecule of protoxide of nitrogen.

†† *Poggendorff's Annalen*, c. 369; and *Annales de Chimie et de Physique*, 3rd series, l. 505.

On the Calorific Phenomena which Accompany the Formation of Organic Compounds,* by M. BERTHELOT.

THE author proposes to inquire what are the calorific phenomena which govern the formation of organic compounds, or, in other words, to find out what is the nature and extent of work necessary to their synthesis; these he considers fundamental data in chemistry as well as physiology. In these papers he gives a *resumé* of the experimental results arrived at with the principal classes of organic compounds. His reasonings, in general, rest upon the principle of active forces; they consist in comparing two equivalent systems—susceptible, on the one part, of being transformed one into the other; and in the other part of furnishing, by complete combustion, the same amounts of water and carbonic acid. In the calculations he relies partly on Dulong's determinations of the heats of combustion, but more especially on the data furnished by MM. Favre and Silbermann.

I. Carbides of Hydrogen.—The carbides $C_{2n}H_{2n}$ preserve very nearly the calorific energy of their elements. Thus olefiant gas C_4H_4 produces 324 units of heat, its elements furnishing 326; ‡ the combustion of amylene $C_{10}H_{10}$ produces 804, that of its elements 815. These numbers are as close as possible; and their slight differences may be attributed to changes of state and physical arrangements. It has been shown that we can argue with certainty upon differences which do not exceed two or three hundredths of the principal quantities. The heat of the combustion of ethalene $C_{32}H_{32}$, however, is lower by $\frac{1}{18}$th than that of its elements, and in this case we must regard the difference as representing the heat disengaged in the formation of a carbide so condensed and so little volatile.

2. In general we may calculate very nearly the heat of combustion of a carbide C_2nH_2n of an alcohol, an ether, and an acid, by adding to that of a homologous body from which it differs by nC_2H_2, the number $n \times 155$. Since C_2H_2 answers to 163, the difference 8 expresses the mean work expended in the transformation of a body into its homologue; that is, $\frac{1}{20}$th of the heat produced by the combustion of the elements which we add to or subtract from the homologous body.

3. The heat of combustion of the oils of turpentine and lemon $C_{20}H_{16}$, carbides endowed with rotatory power, differs but little from that of their elements; but that of terebene, a carbide deprived of rotatory power, and derived from a transformation of the preceding bodies, is lower by $\frac{1}{85}$th. Thus a body optically active changed into an inactive isomer gives rise to a disengagement of heat.

4. The transformation of a carbide into a polymeric body also gives rise to a disengagement of heat. This is remarked in the complete transformation of terebinthene into polymers under the influence of fluoride of boron. Thus the heat of combustion of amylene as stated above is 804, but that of tretamylene $(C_{10}H_{10})_4$ is only 3060. This loss of heat is always correlative with an increase of density and boiling point.

While the equivalent and vapour density are doubled in polymers, the specific heat scarcely changes, a circumstance very important in the discussion of the atomic weights of simple and compound bodies. It proves that these cannot be determined absolutely (otherwise than to a near multiple) by the specific heats.

5. The type of carbides formed with disengagement

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* *Comptes Rendus*, t. lx., p. 485.

† $C_2 = 94$. $H_2 = 69$.

of heat is *formene*, or marsh gas, C_2H_4. Its combustion gives 210 units of heat, and that of its elements 232; whence it follows that the production of formene in its actual state disengages 22 units of heat; this is nearly the same quantity of heat which answers to the formation of the same volume of NH_3,HCl, the third of that relative to H_2O_2.

6. The following comparison deserves some attention: Let us suppose that the heat of combustion of the formenic carbides, $C_{2n}H_{2n+2}$ may be calculated by adding $n \times 155$ to that of formene, according to the law observed in the various homologous series of carbides, alcohols, acids, etc.; we know further that between the ethylenic carbides $C_{2n}H_{2n}$ and the formenic carbides $C_{2n}H_{2n+2}$ there exist experimental relations of analysis and synthesis. Let us see the calorific effects which accompany these metamorphoses. The system $C_4H_4 + H_2$ produces in burning $334 + 69 = 403$ units of heat; the system C_4H_6 will produce $210 + 155 = 365$ units.

The union of an ethylenic carbide with hydrogen to form a hydride will give rise to the disengagement of heat, and the inverse transformation to an absorption. It is easy to show that these conclusions are conformable to the production of hydride of ethylene in the reaction of water on iodide of ethylene.

The carbides $C_{2n}H_{2n}$ disengage heat not only in uniting with hydrogen, H_2, but also with oxygen, O_4, as I shall presently prove; with chlorine, with bromine, Br_2, as it is easy to verify; and with the hydracids, as I have observed in the case of amylene. This circumstance, and the conservation of the calorific energy of their elements prove that they are true radicals of organic combinations.

II. Alcohols. — By fixing the elements of water upon olefiant gas I have obtained ordinary alcohol; by oxidising marsh gas I have obtained methylic alcohol; let us examine what calorific phenomena answer to these general methods of synthesis.

1. The formation of ordinary alcohol by hydration seems to involve only a slight disengagement of heat, for the heat of combustion of alcohol 321 (mean of Dulong, Andrews, Favre, and Silbermann) is rather less than 334, that of the equivalent system $C_4H_4 + H_2O_2$.

Analogous relations exist between amylene and ordinary amylic alcohol; the heat which is disengaged in changing the carbide into the alcohol will be equal to one-fiftieth of the heat of combustion of the carbide. These differences are low enough to be open to a doubt. They prove that the carbide derived from the decomposition of the alcohol into water and carbide, or the alcohol obtained by the inverse synthesis, preserve almost entirely the calorific energy of the initial system.

2. The method of oxidation produces more characteristic effects. Let there be two systems expressed by the equation—

$$C_2H_4 + O_2 = C_2H_4O_2.$$

The combustion of the first gives 210 units of heat; that of the second 170; whence it results that the transformation of marsh gas into methylic alcohol disengages 40 units. This is about the quantity of heat that will result from the union of the hydrogen with the same volume of oxygen.

The relations between homologous bodies seems to allow a generalisation of these facts. Perhaps we may even apply them to the polyatomic alcohols. Such will be the analogous transformation of the carbide $C_{12}H_{12}$ into glucose $C_{12}H_{12}O_{12}$, that is to say into a polyatomic alcohol—

$$C_{12}H_{12} + 6O_2 = C_{12}H_{12}O_{12}.$$

$C_{12}H_{12}$ produces 959 units of heat; $C_{12}H_{12}O_{12}$ 726; the difference 233 divided by $6 = 39$. The formation of sugar thus enters into the general law of alcohols.

Let us now trace the successive reactions by which we change formene into methylic alcohol, and compare them with similar mineral reactions performed upon hydrogen.

$$C_2H_4 + Cl_2 = C_2H_3 + HCl \qquad H_2 + Cl_2 = HCl + HCl$$
$$C_2H_3Cl + KO.HO = KCl + C_2H_4O_2$$
$$HCl + KO.HO = KCl + H_2O_2$$

As the transformation of marsh gas into alcohol produces less heat than that of hydrogen into water, we may conclude from what has preceded that the mineral reactions which intervene in the case of marsh gas—that is to say, the final metamorphosis of chlorine and potash into hydrochloric acid and chloride of potassium, have not liberated the same amount of heat that would have been disengaged if these reactions had been exerted between chlorine, free hydrogen, and potash. A part of the heat of the formation of hydrochloric acid and chloride of potassium is absorbed in the synthesis of methylic alcohol.

In the next communication I shall examine the formation of aldehydes, ethers, acids, amides, &c.

On the Action of Sea Water upon certain Metals and Alloys, by F. CRACE CALVERT, *Ph.D., F.R.S., F.C.S., &c., and* R. JOHNSON, *F.C.S.*

WE were induced to examine the action exerted by sea water, in consequence of the rapid changes which have taken place of late years in naval architecture, and especially in the substitution of metals and alloys for wood.

To carry out the above views, we took 20 square centimetres of each metal, which we cleaned with great care and attention, in order that the action of the sea water might have its full effect; then two plates of each metal were placed in separate glass vessels, and immersed in equal volumes of sea water. After one month the plates were taken out, and any compounds that had adhered to the surface carefully removed; the plates were then dried and re-weighed, and the loss estimated. To render our results of more practical value, we have calculated the action of 100 litres of sea water upon one square metre of each metal, and the following are the amounts of metals dissolved:—

	Grammes.
Steel	29·16
Iron	27·37
Copper (best selected)	12·96
„ (rough cake)	13·85
Zinc	5·66
Galvanised iron	1·12
Block tin	1·45
Stream tin	1·45
Lead (virgin)	trace
„ (common)	trace

These results appear to us to lead to the following conclusions:—

1. That the metal now most in vogue for shipbuilding —namely, iron, is that which is most readily attacked.

2. That this metal is most materially preserved from the action of sea water when coated with zinc, and therefore, in our opinion, it would amply repay shipbuilders to use galvanised iron as a substitute for that metal itself.

The above facts perfectly confirm those which we have already published in our paper "*On Galvanised Iron for Armour Plated Ships*," in which it was shown, that when iron was in contact with oak they mutually acted upon each other, producing a rapid destruction of the two materials, whilst little or no action took place between galvanised iron and the wood.

3. The extraordinary resistance which lead offers to the action of sea water naturally suggests its use as a preservative to iron vessels against the destructive action of that element; and although we are aware that pure lead is too soft to withstand the wear and tear which ship bottoms are subjected to, still we feel that an alloy of lead could be devised which would meet the requirements of shipbuilders.

Feeling that experiments made with a limited amount of sea water might not be a fair criterion of the action of the ocean upon metals, we repeated our experiments upon plates of 40 centimetres square, which were immersed for one month in the sea on the western coast (Fleetwood), taking the precaution that they should be constantly beneath the surface of the water, and suspended by flax rope attached to a wooden structure, to prevent any galvanic action taking place between the plates and the structure to which they were attached.

The following are the amounts of metals dissolved:—

	Grammes.
Steel	105·31
Iron	99·30
Copper (best selected)	29·72
Zinc	34·34
Galvanised iron	14·42
Lead (virgin)	25·69
,, (common)	25·85

The above figures suggest the following remarks:—

That the action has been much more intense in this instance than when the metals were placed in a limited amount of water at the laboratory. These results are due probably to several causes acting at the same time, viz., that the metal was exposed to the constantly renewing surface of an active agent; and that there was also a considerable friction exerted on the surface of the plate by the constant motion of the water, there being at Fleetwood a powerful tide and rough seas. What substantiates this opinion is, that the lead plates undoubtedly lost the greater part of the weight, not by the solvent action of the sea water, but from particles of lead detached from them in consequence of their coming in contact with sand and the wooden supports to which they were attached; but this cause of destruction having been observed with lead plates, it was afterwards carefully guarded against in the case of all the other metal plates.

We also deemed it desirable to examine the action of sea water on various brasses. We therefore immersed for one month plates of various alloys in that fluid, and proceeded to record our results:—

ACTION OF 200 LITRES OF SEA WATER UPON ONE SQUARE METRE SURFACE OF THE FOLLOWING BRASSES:—

Composition of the Brasses.		*Quantity of Metals Dissolved.*			
		Iron.	Copper.	Zinc.	Total.
Pure copper	50				
Pure zinc	50				
	100	—	1·110	10·537	11·647
Commercial brass:					
Copper	66·				
Zinc	32·5				
Iron and lead	1·5				
	100	0·579	3·667	3·324	7·570
Muntz metal (sheet):					
Copper	70·				
Zinc	29·2				
Iron and lead	0·8				
	100·0	0·438	4·226	2·721	7·385
Muntz metal (bars):					
Copper	62				
Zinc	37				
Lead and iron	1				
	100·0	0·501	2·697	3·493	6·691
Prepared brass:					
Copper	50				
Zinc	48				
Tin	2				
	100	Tin. 0·365	7·04	3·477	10·882

The above table shows how very differently sea water acts upon divers brasses and the influence exercised upon the copper and the zinc composing them by the existence in them of a very small proportion of another metal; thus, in pure brass the zinc is most rapidly dissolved (which, *en passant*, is the contrary to what takes place in galvanised iron), whilst it acts as a preservative to the copper.

Tin, on the other hand, appears to preserve the zinc, but to assist the action of sea water upon the copper.

The great difference between the action of sea water upon pure copper and upon Muntz metal seems to us to be due not only to the fact that copper is alloyed to zinc, but to the small proportion of lead and iron which that alloy contains, and there can be no doubt that shipbuilders derive great benefit by using it for the keels of their vessels.

We were so surprised at the inaction of sea water upon lead that we were induced to compare its action with that of several distinct varieties of water, viz., Manchester Corporation water, well water, distilled water in contact with air, the same deprived of air, and the following are the amounts of metals dissolved by 200 litres of these waters upon one square metre of surface during eight weeks:—

	Grammes.
Manchester Corporation water	2·094
Well water	1·477
Distilled water (with air)	110·003
,, ,, (without air)	1·829
Sea water	0·038

These figures require no comment, as they confirm our previous result that sea water has no action on lead.

Contributions to the History of the Metals in Cerite and Gadolinite, by M. MARC DELAFONTAINE.*

(Continued from page 160.)

THE least coloured earths precipitated and assorted as before described were redissolved in nitric acid and subjected to a new series of partial precipitations, for the purpose of separating from them the greatest possible amount of erbia, but a small portion of erbia will always remain in solution. I then mixed the erbia thus obtained with the first lot, transformed the whole into neutral nitrate, diluted with seven or eight times its weight of water. Erbia predominated in this liquid, but small quantities of terbia and yttria were present; by saturating it, when hot, with powdered sulphate of potash, I

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* *Archives des Sciences Physiques et Naturelles, Geneva.*

determined in it the formation of a soluble double erbio-potassic salt, soluble in pure boiling water, but insoluble in presence of an excess of sulphate of potash. It was then easy to extract the base in a perfectly pure state.

For greater certainty, I again dissolved it, and once more submitted it to the same treatment. The impure terbia was, on the other hand, precipitated by an excess of caustic potash, and set aside for future researches.

I found erbia to possess the following characteristics, and it will be seen that they agree with those assigned to it by Mosander:—Precipitated when hot by an excess of alkali, it forms a white gelatinous hydrate, which washes perfectly well on the filter, and does not turn yellow by contact with the air, but absorbs from it a large quantity of carbonic acid. This hydrate dissolves with the greatest ease in diluted acids, and produces salts sometimes almost colourless, sometimes with a pale amethyst tint. Treated with a quantity of concentrated nitric acid insufficient to saturate it, it first forms a yellow subsalt, which loses its colour on the addition of water and acid. Its neutral nitrate solution slowly concentrated, then evaporated to dryness, forms a white, very slightly deliquescent mass; at a higher temperature, this mass fuses, forming a dark yellow limpid glass, which, by slow and steady cooling, sometimes solidifies without change in appearance; if its surface is then lightly scraped with a spatula, it cracks, and becomes white, with a radiated structure. By increasing the heat, the decomposition of nitrate of erbia is determined, first into a dark, reddish-yellow basic salt, then into a pure oxide. The subnitrate is formed by incompletely precipitating the hot neutral salt by pure ammonia. The erbic hydrate loses all its water at a red heat, assuming a dark yellow colour, often approaching orange. The lumps do not separate; they are heavy, broken with difficulty, and dissolve slowly in acids, leaving no residue, but disengaging a little oxygen. Obtained by the calcination of its oxalate, erbia is much more finely divided, and its pale yellow tint makes it easily confounded with pure ceroso-ceric oxide. Kept for a long time at a high temperature in a closed vessel, it turns white, and loses a little oxygen; in this property it resembles oxide of didymium. It is insoluble in potash, and when hot expels ammonia from its salts.

To establish very precisely the individuality of erbia, I made a comparative analysis between its sulphate and the corresponding salts of yttria and terbia, prepared under entirely identical conditions. For this purpose I dissolved, in a considerable excess of diluted sulphuric acid, the erbia above described, several grammes of pure yttria, and an earth composed essentially of terbia; the liquids, concentrated very slowly by means of gentle heat, deposited at about 80°, distinct and abundant crystals of earthy sulphates. Those of the first two earths were slightly rose-coloured, the colour of the terbia crystals being much more pronounced. M. Marignac kindly made a crystallographic examination examination of them, and found them to be perfectly isomorphic one with another, and with sulphate of didymium.

The general formula of these three sulphates is then $(RO,SO_3)_3 + 8$ aq.; and the difference in the nature of their bases is given, as I shall show, by the different relative proportions of their component parts.

In making my analysis, I dried the salts at about 110° after having reduced them to a fine powder, moistened with water to extract the portions of acid mother liquor they retain, pressed in filtering paper, and finally kept for some hours under a receiver, beside a vessel of sulphuric acid.

The residue thrown into cold water dissolved rapidly provided it was prevented from agglomerating by continual stirring. Erbia having a great tendency to form basic salts, it appeared to me better in estimating it to use neutral ammonic oxalate instead of a caustic alkali. By precipitation, which I effected when cold, it gave a finely divided deposit, which passed readily through the filter; this may be prevented by the addition of a little ammonic chloride, in which it is insoluble. On operating with hot erbia, the oxalate was crystalline, but as it does not form all at once, only one portion crystallises in several hours, attaching itself firmly to the rod and the sides of the vessel, and hence some uncertainty as to the result. Yttric oxalate traverses the filter much more readily than the other two.

In the conditions under which I operated, that is to say with a rather diluted liquid, an excess of reagent is no inconvenience. After washing and drying the precipitate was calcined at nearly white heat, cooled while protected from the air, and immediately weighed.

Erbic Sulphate.—0·827 gr. lost 0·177 = 21·40 per cent. of water and gave 0·353 = 42·68 per cent. of erbia.

1·0485 of salt lost 0·226 = 21·55 per cent. and gave 0·4475 = 42·68 per cent. of erbia.

For 0·803 I obtained: water 0·171 (21·29 per cent.) and earth 0·3415 (42·53 per cent.).

Another product obtained with an earth produced by a different treatment of gadolinite.

1·232 gave water 0·264 (21·43 per cent.) and earth 0·523 (42·45 per cent.).

1·1505 gave, earth 0·495 (42·60 per cent.).

	I.	II.	III.	IV.	V.	Mean.
Erbia .	42·68	42·68	42·53	42·45	42·60	42·59
Water.	21·40	21·55	21·29	21·43		21·42

The above results give the number 596 for the atomic weight of erbia, according to which the calculated composition of sulphate would be:—

		Calculated.	Found.
$3ErO$ =	1788	42·69	42·59
$3SO_3$ =	1500	35·82	
8*Aq.* =	900	21·49	21·42
	4188	100·00	

I endeavoured to effect the decomposition of sulphate of erbia by heat alone.

1·082 of sulphate calcined at white heat until its weight became fixed, gave 0·5765 of subsalt; thus only two-thirds of sulphuric acid were expelled.

Sulphate of Terbia.—1g. 294 gave 0·2795 (21·60 per cent.) of water, and 0·5405 (41·77 per cent.) of nearly white earth.

1·009 gave 0·220 (21·80 per cent.) of water and 0·4215 (41·77 per cent.) of earth.

1·271 gave 0·2755 (21·68 per cent.) of water and 0·5265 (41·42 per cent.) of earth.

	I.	II.	III.	Mean.
Terbia .	41·77	41·77	41·42	41·65
Water .	21·60	21·80	21·68	21·69

Mean atomic weight, 571.

The calculated composition of the sulphate is,—

		Calculated.	Found.
$3TeO$	1713	41·65	41·65
$3SO_3$	1500	36·47	
8*Aq.*	900	21·88	21·69
	4113		

Sulphate of Yttria.—0·9545 gave 0·216 (22·68 per cent.) of water and 0·371 (38·87 per cent.) of yttria.

2g. 485 gave 0·565 (22·74 per cent.) of water, and 0·9585 (88·57 per cent.) of yttria.

2g. 153 lost 0·4935 (22·92 per cent.) of water, and gave 0·827 (38·41 per cent.) of earth.

Yttria	38·87	38·57	38·41	38·62
Water	22·68	22·74	22·92	22·78

Mean atomic weight, 500.†

Calculated composition of sulphate,—

		Calculated.	Found.
$3YO$	1500	38·46	38·62
$5SO_3$	1500	38·46	
8 *Aq.*	900	23·08	22·78
		3900	100·

According to the above the atomic weight of erbia would be very near 596. This number cannot be assigned to any of the analogous earths, without the supposition of grave errors in the results of my analyses, to which I have given the greatest attention; but as it is intermediate between those of cerous or didymic oxides and of yttria, chemists little accustomed to the study of these substances may suppose erbia to be simply a mixture of yttria and ceria or didymia.

(To be continued.)

On the Electrolytic Precipitation of Copper and Nickel as a Method of Analysis, by WOLCOTT GIBBS, *M.D.*

THE precipitation of copper by zinc, in a platinum vessel, with the precautions recommended by Fresenius, leaves nothing to be desired, so far as accuracy, ease, and rapidity of execution are concerned. The method labours, however, under a single disadvantage—the introduction of zinc renders it difficult, or at least inconvenient, to determine with accuracy other elements which may be present with the copper. It has occurred to me that this difficulty might be overcome, the principle of the method being still retained, by precipitating the copper by electrolysis with a separate rheomotor. The following numerical results, which are due to Mr. E. V. M'Candless, will satisfactorily show the advantages of the method for the particular cases in which it is desirable to employ it. The copper was in each case in the form of sulphate; the deposition took place in a small platinum capsule, which was made to form the negative electrode of a Bunsen's battery of one or two cells, in rather feeble action. The positive electrode consisted of a stout platinum wire, plunged into the surface of the solution of copper at its centre. The following table gives the results obtained in the analysis of pure sulphate of copper:—

Number.	Salt taken.	Copper found.	Percentage.
1. . .	1·2375	0·3145	25·41
2. . .	0·4235	0·1075	25·38
3. . .	1·0640	0·2705	25·42
4. . .	1·3580	0·3440	25·33
5. . .	0·5665	0·1450	25·59
6. . .	0·4735	0·1205	25·48

In seven determinations of copper in the alloy of copper and nickel employed by the Government for small coins the following results were obtained:—

Number.	Weight of alloy.	Copper.	Percentage.
1. . .	0·4160	0·3640	87·50
2. . .	0·6180	0·5410	87·54
3. . .	0·4600	0·4090	88·91
4. . .	0·5120	0·4481	87·51
5. . .	0·4220	0·3693	87·51
6. . .	0·2525	0·2225	88·11
7. . .	0·3705	0·3255	87·85

The percentage of copper required by the formula CuO,SO_3+5HO is 25·42, while the Government standard alloy of nickel and copper contains 87·50 per cent. of copper. The time required for precipitation varied from one to three hours, the separation of the last traces of copper being in each case determined by testing a drop of the liquid upon a porcelain plate with sulphuretted hydrogen water. The copper after precipitation was washed with distilled water, dried in a vacuo over sulphuric acid, and weighed with the platinum vessel. The only precaution necessary is to regulate the strength of the current so that the copper may be precipitated as a compact and bright metallic coating, and to dry as quickly as possible. When the copper is thrown down in a spongy condition, it not only oxidises rapidly, but it is impossible to wash out the last traces of foreign matter contained in the solution. This is well shown by No. 3 and No. 4 of the second series, in both of which cases the copper was precipitated too rapidly. The solution from which the copper has been deposited contains the other elements present in the original substance. It may be easily poured off without loss, and the washings added.

It appears at least probable that nickel may be determined by electrolysis in the same manner as copper, the solution employed being the ammoniacal sulphate with excess of free ammonia. Mr. M'Candless obtained in two determinations in a commercial sample 91·36 and 91·60 per cent. of nickel. In both cases the nickel was thrown down completely as a bright, coherent, metallic coating upon the platinum. — *American Journal of Science and Arts*, vol. xxxix., No 115.

TECHNICAL CHEMISTRY.

Apparatus for the Decomposition of Pyrophosphate of Iron and Regeneration of Phosphorus.

THIS apparatus, which is shown in the plate, has been devised by MM. Minary and Soudry, for obtaining phosphorus from the pyrophosphate of iron in forge cinders. It consists of an earthern furnace placed on a thick iron plate pierced with holes to allow of the introduction of air and the passing away of the cinder. Below this is another iron plate, which prevents the cinder falling on the lower portions of the apparatus, and which has a single hole in the centre to allow of the introduction of a porcelain tube. This porcelain tube is closed at the top, and half filled with vitrified phosphate of iron pulverised and mixed with coke dust. The bottom is closed by a cork traversed by a glass tube, wide-mouthed at the top, and opening at the bottom into a small closed receiver, two-thirds filled with distilled water. This is closed with cork at the top, which has a tube passing into the cistern through which the gas passes into the gas-receiver.

From 15 to 20 grammes of finely powdered vitrified phosphate of iron, mixed with 60 grammes of well calcined coke, is introduced into the porcelain tube, and

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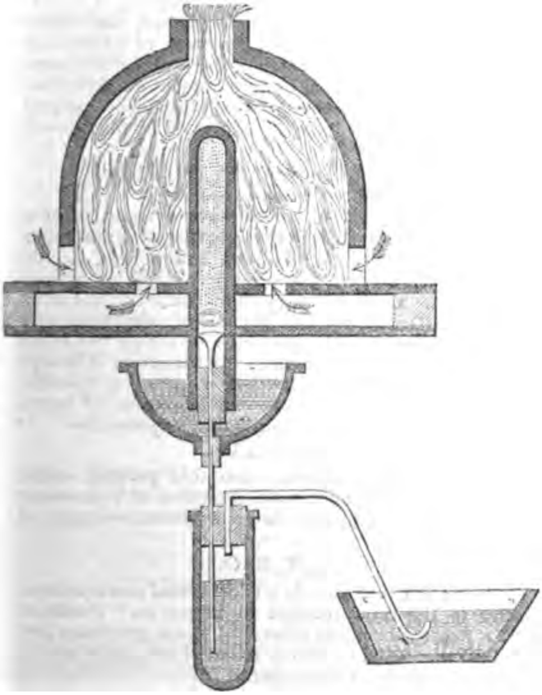
† It should be borne in mind that these numbers do not pretend to represent the exact atomic weights of the respective bodies; they are useful simply as a means of comparison, for showing in a more striking manner the existence of three earths in yttria. I believe, however, that the first and the last are very nearly exact, the second requires reconsideration.

then tightly tamped with asbestos, after which the tube is closed with a cork in the manner stated above. The furnace is then slowly fired, so as to avoid a breakage of the tube; but subsequently the draft is increased and the temperature raised to a red heat. The phosphate of iron is decomposed, and the phosphorus distilled over is condensed in the water of the closed receiver in a state of white powder if the water is cold, but in a liquid state if the temperature of the water is raised to 50° Cent. (122° Fahr.)



If the coke has been previously well calcined, nothing escapes into the gas-receiver but oxide of carbon, the phosphorus being almost wholly collected in the closed receiver. If, however, the coke has not been thoroughly calcined, and still contains hydrocarbides, little or no phosphorus is collected, for it escapes into the gas-receiver as phosphuretted hydrogen, burning, as it escapes into the atmosphere, with great intensity and brilliancy. It is worth noting that when the phosphorus thus escapes, instead of being distilled and condensed, the operation is much more rapid.—*Mining and Smelting Magazine.*

PHYSICAL SCIENCE.

On the Disappearance of the Spectrum of ε Piscium at its Occultation of January 4, 1865; with Conclusions as to the Non-existence of a Lunar Atmosphere, by WILLIAM HUGGINS, *Esq.*

In a paper recently presented to the Royal Society by myself and Dr. W. A. Miller, we gave the results of repeated prismatic examinations of different parts of the moon's illuminated surface. Since all these results were negative, they cannot be regarded as conclusive, but the amount of weight to which they may be entitled is opposed to the existence of a lunar atmosphere of considerable extent.

An observation which might furnish some information on this point still remained to be attempted—namely, that of the spectrum of a star a little before, and at the moment of, its occultation by the dark limb of the moon. It is well known that from ordinary telescopic observation of the disappearance of a star under those circumstances, no indications of a lunar atmosphere have been detected. From the absence of such indications, "we are," according to Sir John Herschel, "entitled to conclude the non-existence of any atmosphere at the moon's edge having one 1980th part of the density of the earth's atmosphere."

When, however, the observation is made upon the spectrum of a star, before, and at the moment of, its disappearance, several phenomena characteristic of the passage of the star's light through an atmosphere might possibly present themselves to the observer.

If a lunar atmosphere exist, which either by the substances of which it is composed, or by the vapours diffused through it, can exert a selective absorption upon the star's light, this absorption would be indicated to us by the appearance in the spectrum of new dark lines immediately before the star is occulted by the moon.

Again, if finely divided matter, aqueous or otherwise, of the nature of "fog" were present in the moon's atmosphere (a supposition to which telescopic observation is opposed), or even any considerable amount of invisible vapour, the red rays of the star's light would be enfeebled in a smaller degree than the rays of higher refrangibilities. In this case the blue end of the spectrum would appear to fade, leaving the red rays comparatively undiminished in brightness at the moment of the star's extinction.

If, however, there be about the moon an atmosphere free from "vapour," but of some density, then, because of the greater refraction which the more refrangible rays of the star's light would suffer in passing through it, the blue end of the spectrum would continue visible for a very small interval after the red rays had disappeared. Even if the moon's atmosphere were not of great extent, but sufficiently dense, the spectrum would probably not be extinguished at the same instant throuhout its length, but a lagging of the violet and blue rays behind the red would be perceptible.

The telescope has an aperture of eight inches in diameter, and a focal length of ten feet. In the spectrum apparatus two prisms were employed, one having a refracting angle of 35°, the other of 45°. The spectrum was viewed through a small achromatic telescope of 6·75 inches focal length, furnished with an eyepiece magnifying nine diameters.

The telescope armed with this special apparatus was directed to ε *Piscium* about five minutes before the almanac-time of the occultation, which was 5 h. 53 m. The clock-motion carrying the telescope was carefully adjusted, and by this means the image of the star was kept exactly upon the narrow slit of the spectrum apparatus.

During a period of three minutes, up to the disappearance of the star, I was able to observe the spectrum steadily and without interruption. Of the first point of interest, whether any dark lines additional to those belonging to the star appeared, I hesitate to speak decidedly. The state of our atmosphere was constantly varying, in consequence of which the stellar lines were seen with more distinctness at some moments than at others. A few seconds before the extinction of the star, I saw distinctly some lines in the red, which I had not before noticed. These lines, however, might have belonged to the star, and have been brought out by a greater steadiness of our atmosphere at that moment.

The mode of disappearance of the spectrum of ε *Piscium* I can describe with more certainty. The spectrum did not go out in the manner for which I was prepared. I expected the spectrum would disappear by a sudden failure of its light, but such was not the impression produced at the moment of extinction.

The appearance suggested an opaque screen, equal in length to the spectrum, passing before it with a rapid motion in the direction of its breadth. On this occasion the spectrum as seen in the instrument was very narrow.

The duration of the blotting out of the spectrum in this manner, though it was so small that it might perhaps be called instantaneous, yet occupied an interval of time which could be appreciated. This interval did not differ greatly from two tenths of a second.

I was not able to detect that the disappearance of the spectrum was preceded by any failure of the blue, or of the red rays, but the spectrum appeared to remain unaltered in the relative intensity of its different parts up to the moment of extinction.

The advance of darkness upon the spectrum, since it occurred precisely in the direction of its breadth, swallowed up the rays of different refrangibilities throughout the whole extent of the visible spectrum, at the same instant.

The difficulties which attend the successful application of spectrum analysis to the heavenly bodies are so great, that much importance ought not to be given to a single observation of which the results are negative. A series of spectrum observations of the occultations of stars, especially if the list included some stars of greater brightness than ε *Piscium*, might possibly afford us information of interest and value.—*Monthly Notices of the Astronomical Society.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, April 6.

Professor W. A. MILLER, *M.D., F.R.S., President, in the Chair.*

THE minutes of the anniversary meeting and of the two previous ordinary meetings were read and confirmed. Mr. George Jones was formally admitted a Fellow of the Society, and Mr. A. Vernon Harcourt, M.A., took the duties of Secretary. For the first time were proposed the names of Dr. Holtzmann, Marlborough House; Mr. Thomas C. Kirkham, Brompton; and Mr. Joseph Sugden, jun., Trinity House, Halifax. The names of W E. Heathfield, F.R.G.S., Princes Square, Finsbury, and Mr. Arthur Clegg Bowdler, Oxford Road, Manchester, were read for the second time. The ballot was taken for the undermentioned gentlemen, after their certificates had been read for the third time, and they were declared to be duly elected as Fellows of the Society—viz., Mr. Robert Barton, Bushy Park, Teddington; Mr. C. H. Berger, Lower Clapton; Mr. William Chrispin, Darlington, Durham; Mr. Alexander W. Gillman, Southfield, Wandsworth; Mr. Arthur S. Hobson, 3, Upper Heathfield Terrace, Turnham Green; Mr. William Judd, High Street, Christchurch, Hants; Michael Foster, jun., M.D., Huntingdon; and Mr. George B. Robertson, Cathcart Hill, Upper Holloway, and Stamp Office, Somerset House.

Mr. W. H. PERKIN read a "*Note on a New Bromine Derivative of Camphor.*" By the action of heat upon Laurent's bromide of camphor, $C_{10}H_{16}OBr_2$, the author found, contrary to the statement of Gerhardt, that hydrobromic acid was eliminated with production of an oily substance which ultimately solidified into transparent prismatic crystals, very similar in appearance to sulphate of soda, or it took the form, when impure, of tufts of needle-shaped crystals. The crude product was washed with weak alkali to remove every trace of hydrobromic acid and submitted to distillation, the liquid which passed over being further purified by a solution and crystallisation from alcohol. The change which bromide of camphor undergoes when heated may be expressed by the following equation—

$$\underset{\text{Bromide of camphor.}}{C_{10}H_{16}OBr_2} = \underset{\text{Bromo-camphor.}}{C_{10}H_{15}BrO} + HBr.$$

The crystals of bromo-camphor have a slight odour of camphor, but their taste is very similar to oil of turpentine. They fuse at 76° or 77° C., and boil at 274° C.; the crystals are, however, appreciably volatile at ordinary temperatures. Heated with alcoholic ammonia in a sealed tube the substance furnished bromide of ammonium and a peculiar organic base, the properties of which the author is now engaged in investigating. By the action of bromine upon bromo-camphor the author obtained a crystalline mass, which he believes to be the bibromide of bromocamphor, the formula of which is thus expressed—

$$C_{10}H_{15}BrO,Br_2.$$

Again, by the action of heat upon this product another crystalline body is formed with evolution of hydrobromic acid, the result is supposed to be a bibromo-camphor of the formula,

$$C_{10}H_{14}Br_2O.$$

Professor WANKLYN made a short verbal communication relative to the interpretation to be put on "*Friedel and Craft's Researches on the Ethers.*" These gentlemen have examined the action of iodide of ethyl on amylic alcohol, and find the products to consist of

1. Water;
2. Hydriodic acid;
3. Oxide of ethyl-amyl;
4. Iodide of amyl.

The following equations will explain the formation of these products:—

$$\text{I.}\quad \left.\begin{matrix}C_2H_5\\I\end{matrix}\right\} + \left.\begin{matrix}C_5H_{11}\\H\end{matrix}\right\}O = \left.\begin{matrix}H\\I\end{matrix}\right\} + \left.\begin{matrix}C_5H_{11}\\C_2H_5\end{matrix}\right\}O.$$

$$\text{II.}\quad \left.\begin{matrix}H\\I\end{matrix}\right\} + \left.\begin{matrix}C_5H_{11}\\H\end{matrix}\right\}O = \left.\begin{matrix}C_5H_{11}\\I\end{matrix}\right\} + \left.\begin{matrix}H\\H\end{matrix}\right\}O.$$

On extending their researches so as to include the action of the acetic ethers on the alcohols, they noticed a very remarkable fact—viz., that under these circumstances there was no formation of water, nor of acid, nor of oxides of alcohol-radicals. Thus, on exposing a mixture of acetate of amyl and common alcohol to a temperature of 240°C. for forty hours the only products were:—

1. Acetate of ethyl;
2. Amylic alcohol.

There was consequently no water, nor acetic acid, nor oxide of ethyl-amyl.

In like manner a mixture of benzoate of ethyl and amylic alcohol gave only—

1. Benzoate of amyl;
2. Ethylic alcohol.*

Professor Wanklyn then asked, "Why do not benzoate of ethyl and iodide of ethyl re-act in an analogous manner on an alcohol?" The theory which the author recently proposed is considered to furnish an explanation of this anomaly—viz., that, whilst the iodides and certain other ethers are really compounds of the alcohol-radicals, the acetic and benzoic ethers, &c., are salts of the so-called acid-forming radicals.

In the following equation the reaction is represented as an exchange of acetyl against hydrogen, and is evidently

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* Liebig's *Annalen*, February, 1865, p. 209 *et seq.*

analogous to the first equation representing the action of iodide of ethyl on amylic alcohol:—

$$\left.\begin{matrix}C_5H_{11}O\\C_2H_3O\end{matrix}\right\} + \left.\begin{matrix}C_2H_5\\H\end{matrix}\right\} O = \left.\begin{matrix}C_5H_{11}O\\H\end{matrix}\right\} + \left.\begin{matrix}C_2H_5\\C_2H_3O\end{matrix}\right\} O.$$

Consequently, when iodide of ethyl acts on an alcohol ethyl changes against hydrogen; and when ethylate of acetyl acts on an alcohol acetyl changes against hydrogen. Thus Professor Wanklyn claims for his theory the advantage of establishing a parallel between the reactions, although the actual products in the two instances are different.

Mr. **John A. R. Newlands** then gave an account of "*An Ammoniacal Deposit formed in the Process of Drying Blood.*" When visiting the premises of Mr. Richard Tons, of Bow Common, near London, where blood is dried for the purposes of manure, the author noticed a white crystalline deposit, sometimes stalactitic, adhering to an iron steam-pipe, and parts of the roof of a shed erected over the pans in which the process of dessication is carried on. This white crust proved on analysis to consist chiefly of sulphate of ammonium, and an average sample had the following composition:—

	Per cent.
Moisture	0·44
Silicious matter	0·32
Peroxide of iron	1·21
Sulphate of calcium	0·84
Sulphate of ammonium	96·94
Chloride of ammonium	0·07
	99·82

The author accounted for its production by assuming the oxidation of sulphuretted hydrogen by air in the presence of steam and ammoniacal vapours, these gaseous substances being given off simultaneously during the evaporation and decomposition of the animal matters subjected to these processes of manufacture.

Professor **A. H. Church**, M.A., having elicited the information that the "sulphate of ammonium" in the above analytical table was to be understood as being anhydrous, drew a comparison between the circumstances of its formation and that of the natural product, Boussingaultite, containing water of crystallisation, as described at a recent meeting of the Society. With respect to his previous statements relative to the stalactitic varieties of Atacamite, the speaker said that he had discovered upon Tallingite two new hydrated oxychlorides of copper, the formulæ of which were,—

I. $CuCl_2,4CuH_2O_2 + 4aq.$

II. $CuCl_2,6CuH_2O_2 + 6aq.$

The **President** then adjourned the meeting until Thursday, April 20.

ACADEMY OF SCIENCES.

April 3, 1865.

M. **Matteucci** contributed a memoir "*On the Action of Sulphur in the Voltaic Pile.*" The learned author has studied the battery recently introduced by M. Blanc, who employs a plate of zinc and a plate of lead covered with a very thin deposit of copper, which are placed in a solution of common salt, with which is mixed a quantity of flowers of sulphur. This battery appears to be very useful for telegraphic purposes, and the only objection to its use is the evolution of some sulphuretted hydrogen, which would seem to be unavoidable. In the course of his experiments the author arrived at the following conclusions:—1. That finely divided sulphur in contact with the electro-negative metal of a pile formed of zinc, copper, and solution of common salt notably increased the electro-motive force, constancy, and permanency of the battery, and he hopes to obtain by the use of sulphur a voltaic combination possessing many advantages over the batteries at present employed. 2. Sulphur, although insoluble and an insulator, enters into combination with the sodium set free by the current. It remains for the author to explain the action of the small quantity of sulphide of copper which is formed, and which appears to be essential. For this end he has undertaken further experiments.

M. Naquet contributed a note "*On Thymicylic Acid,*" which he has found was discovered five years ago by Kolbe and Lautemann, who described it under the name of *thymolic acid*. As the original discoverers have not continued the study, M. Naquet hopes to be allowed to continue it himself.

M. A. Saytzett presented a note "*On the Action of Cyanate of Potash on Monochloracetic Ether.*" On boiling these two bodies together for fifteen hours an abundant deposit of chloride of potassium is formed, and a liquid is obtained which a sufficient quantity of ether separates into two layers. The upper layer leaves on distillation a white crystalline body, proved to be allophanic ether, $\text{Ꞓ}_4H_8N_2\text{Ɵ}_3$. The lower stratum was treated first with water to remove any allophanic ether, and the aqueous solution was then treated with dilute sulphuric acid. On cooling this solution deposited crystals of a new acid, $\text{Ꞓ}_6H_8N_2\text{Ɵ}_5$, which the author proposes to call *oxyethylglycolylallophanic acid*, considering it as allophanic acid in which one atom of hydrogen is replaced by the monatomic group $\text{Ꞓ}_2H_2\text{Ɵ}.\text{Ꞓ}_2H_5\text{Ɵ}$, *oxyethylglycolyle*. The author describes several oxyethylglycolylallophanates.

NOTICES OF BOOKS.

Chemical Technology; or, Chemistry in its Applications to the Arts and Manufactures. By **Thomas Richardson**, M.A., P.D., &c., and **Henry Watts**, B.A., F.C.S. Second Edition. Vol. 1, part 4. London: Bailliere. 1865.

The part of this work we now notice—why it is called a "part" we are at a loss to imagine—is one of the most useful yet issued. It embraces an account of the manufacture of aluminium, sodium, soda, phosphorus, lucifer-matches, borax, mineral waters, gunpowder, gun-cotton, fireworks, stannates, tungstates, silicates, and some other important technical applications of chemistry. And when we say that the accounts of these manufactures are as good as can be given, and that to put them into operation it is only necessary that the reader should be possessed of that practical skill without which all reading of the kind is vain, we have said sufficient to show the high value of the work.

In a series of short notices, we propose to run hastily through the principal contents, referring our readers to the work itself for more minute details.

The manufacture of sodium and aluminium are so intimately connected that the two are very properly described together here. Attempts have been made to separate aluminium from its compounds by means of ordinary reducing agents, but without success on the large scale, and with uncertain success on the small. We have, however, seen small pieces of the metal which have been reduced with the aid of ordinary fluxes. Corbelli, of Florence, has in late years patented a method of reducing sulphate of alumina by means of ferrocyanide of potassium; but the metal obtained is said to be largely contaminated with iron. We are told nothing respecting the properties of such an alloy, which may be a useful compound. Cumenge proposes to obtain aluminium from a sulphide prepared by passing the vapour of sulphur over carbon, to produce bisulphide of carbon, and the vapour of this latter over heated alumina. In this stage of the process the carbon of the bisulphide takes the oxygen of the alumina, and the sulphur combines with the aluminium. Several means of reducing this sulphide are given, so as to produce either pure aluminium or alloys. Sir C. F. Knowles reduces aluminium from the chloride by means of alkaline cyanides. Gerhard proposed to reduce fluoride of aluminium directly by means of hydrogen; but the process, which looks simple and easy of execution, has, we are told, been abandoned. Practically, we believe all the aluminium made is obtained by the aid of sodium; and the cheap and easy production of the latter metal is, therefore, a matter of the greatest importance—not for the production of aluminium alone, we may add. The uses of sodium are capable of indefinite extension, and we may regard its cheap production as a matter of great interest.

Nothing can be simpler than the process for obtaining sodium. It consists merely in distilling a mixture of charcoal and dried carbonate of soda. The admixture of chalk is, according to M. Tissier, unnecessary. But, unfortunately, only small quantities of the mixture can be submitted to heat at one time; and hence the application of the process becomes troublesome. The distillation is best effected in mercury bottles, but a so-called continuous process has been adopted, in which the distillation is carried on in cylinders, from which the exhausted charge is more easily withdrawn than from a mercury bottle.

By the aid of sodium, the preparation of aluminium is also extremely simple. A double chloride of aluminium and sodium, in powder, is mixed with small fragments of sodium, and the mixture is thrown upon the hearth of a reverberatory furnace. A vivid reaction soon ensues, and the aluminium is quickly reduced. When cryolite is employed, the operation is generally performed in a crucible, in which a mixture of cryolite and common salt and sodium are arranged in alternate layers. The former process yields the purest aluminium; the latter introduces silicon, if clay crucibles are employed, and iron if crucibles of that metal are used.

Aluminium may be said to be yet on its trial; but, if cheap, it might, no doubt, be applied to many useful and ornamental purposes; and the subject of its preparation is well worth the attention of chemists.

Report on the Air of Mines and Confined Places. By Angus Smith, Ph.D., F.R.S. Part of the Appendix to the Report of the Royal Mines Commission. 1864.

(Concluding notice.)

Dr. Smith has said that the presence of 0·1 per cent. of carbonic acid in an atmosphere is perceptible and hurtful, but it would seem that this is only the case when the gas is accompanied by organic exhalations, for he found the air in a soda-water manufactory, which contained nearly two-tenths per cent. of the acid, produced no discomfort when respired. We must therefore regard the organic matters in the atmosphere as the most serious contaminations, and the estimation of these as of the first importance. Unfortunately the satisfactory estimation is not an easy matter. Permanganate of potash solution, which is used to determine the amount of oxidisable matters, gives results which are very liable to mislead an experimenter, and in fact can hardly be considered *to prove* the presence of organic matter. So many substances are found in the atmosphere that are capable of decolorising a solution of the permanganate, indeed, that very little reliance is to placed in the test. There is, however, a distinctive mode of action. Mineral substances, sulphurous acid and sulphites, sulphuretted hydrogen and sulphides, decolorise the solution instantaneously; organic matters discharge the colour but slowly, and "the slow action of organic matter," says Dr. Smith, "is very convincing when one becomes familiar with it." Under these circumstances any quantitative estimation of organic matters may be disregarded. Their presence in the air of mines, however, may be considered as conclusively established, for besides the permanganate another test was used which may be considered as more reliable. "Part of the material from the tubes was burnt, and the unmistakeable odour of nitrogenous substances was perceived; burnt feathers give it in its ideal purity. As a final proof that organic matter was operated upon, carbon, black and combustible, remained behind." The nose also distinguishes various matters when air brought from mines is blown into the nostrils in a pure atmosphere; and, as Dr. Smith observes, the sense of smell is as much to be relied upon as any other sense. The nose did, in fact, detect in a bag of air brought from a mine the odour of burnt tallow, of tobacco smoke, and also that peculiar apple-like smell which every one will recognise near dirty people in a state of perspiration, and in most crowded assemblies.

Before we leave this part of the subject, we may mention a very simple method proposed by Dr. Smith for arriving at a tolerably close estimation of the amount of carbonic acid in an atmosphere. He starts with a normal solution of caustic baryta or lime, a small quantity of which—say half-an-ounce—he places in a bottle of known capacity filled with the air to be examined; the bottle is then shaken, and the amount of precipitate observed. In an atmosphere highly charged with carbonic acid, a very small volume of air gives a distinct precipitate; greater dilutions, of course, require larger volumes of air to give turbidity. Thus, if in a bottle holding about an ounce in which, allowing for the half-an-ounce of baryta water, there will be twelve cubic centimetres of air, distinct turbidity is caused, Dr. Smith has calculated that such air will contain 2 per cent. of carbonic acid. A table is given here, showing the amounts which may be inferred from experiments with bottles of various sizes. We may at a future time return to this question when we speak of Dr. Smith's experiments in the leaden chamber. We now pass on to notice very briefly the effects of bad air on the miner.

Cornwall appears to be an exceptionally healthy county. Infant mortality is less there than in Norfolk, and women are long-lived. It is only when they arrive at a working age that the lives of the men seem to become precarious, and this in the case of the Cornish miner cannot be attributed to accidental or violent causes. The metal miner is much less exposed to the risk of a violent death than the coal miner. In Cornwall the deaths from violence are only 109 in 100,000; while in coal mines the number is as high as 498 in 100,000. And yet the Cornish miner is a short-lived man. In healthy districts, and with healthy occupations, men at 20 may ensure 100*l.* for an annual premium of 1*l.* 7s. 7d.; but it costs a Cornish miner 1*l.* 17s. a-year to insure the same amount.

No doubt several causes co-operate in deteriorating a miner's health, but there can be no question that impure air has the most baneful influence. The deaths from lung disease are higher in Cornwall than in any other mining district.

Under these circumstances, we regard with much favour the proposal to subject mines to inspection, with a view chiefly to the introduction of improvements in ventilation. We have not the details of Lord Kinnaird's measure before us, but we feel assured that it contemplates nothing which will not prove to be equally advantageous to the proprietor and the miner. The former may, indeed, be considered as more interested in the miner's health than the miner himself; and we hope no ignorant and selfish opposition will defer the passing of a measure from which the most beneficial results may be anticipated.

Zeitschrift für Analytische Chemie. Edited by Dr. C. R. Fresenius. No. 3, 1864.

For a wonder, we may say, this valuable journal contains nothing at once novel and useful for the readers of the Chemical News. Abstracts of most of the papers have already appeared in our pages, and the others are in course of preparation from their original sources.

Chemisches Central Blatt. Nos. 11, 12, 1865.

In the former of these journals we have a paper by the late editor, Dr. Knop, "*On the Recovery of Uranic Oxide from Test Residues and the Preparation of Pure Uranic Oxide.*" The easy recovery of uranic oxide is a matter of some importance to chemists who use the nitrate or acetate of uranium for the determination of phosphoric acid. Salts of uranic oxide give a brown precipitate with ferrocyanide of potassium, which is decomposed by caustic soda or potash, giving ferrocyanide of potassium or sodium, and yellow uranic oxide. To recover the oxide from the phosphate, the author mixes the latter with twice its weight of carbonate of soda, and heats the mixture until it acquires a uniform brown colour. When cold, the soluble matters are extracted with cold water; and the uranium residue is afterwards dissolved in hot hydrochloric acid. This solution is treated with ferrocyanide of potassium, to obtain the brown ferrocyanide of uranium, which is decomposed, as above stated, by a caustic alkali. An excess of the alkali must be avoided. The precipitate, after well washing, is dissolved in boiling acetic acid, to which a little ammonia has been added; and the solution is then allowed to stand for a day. It is then filtered from any phosphate of uranium that may have deposited, and the filtrate is completely precipitated by ammonia. The uranic oxide so precipitated and well washed may be dissolved in acetic acid, and used at once for the determination of phosphoric acid.

A paper by Hosau gives "*The Composition of Dry and Fossil Sepia.*" Many chemists have made a chemical examination of the colouring matter of the cuttle-fish. The author obtained two of the colour-bags, which were very dry and hard, and were said to be very old. The specific gravity of the mass was 1·275. It broke with a conchoidal fracture, and when examined by the microscope appeared as a black amorphous substance, which underwent no change in colour when treated with acetic acid, potash, alcohol. Strong acids attacked it, nitric acid dissolving the greater part with a red colour. Sulphuric acid carbonised it. The mineral ingredients are not fully given by the author, who only remarks that chloride of sodium constitutes the greater part of the alkaline materials. Prout found sulphuric acid and iron, as well as phosphoric acid, iodine, bromine, and sulphur, neither of which the author appears to have discovered. He gives the following as the centesimal proportions of the organic constituents:—C 44·2, H 3·3, N 9·9, O 42·6. The abstract of a paper by Ludwig gives a method of *separating the bitter substance in senna leaves*, which we shall give in another place.

In No. 12 we have a paper by C. Rammelsberg, "*On a New Phosphate of Soda, and the Occurrence of Vanadium Compounds in Soda Ley.*" On evaporating down soda ley for the preparation of caustic soda, small red and yellow crystals have been observed to form before the carbonate of soda crystallises out. These the author shows to be tribasic phosphate of soda, $3NaO\,PO_5 + 20\,aq.$, coloured by vanadium. An article "*On German Portland Cement,*" by Dr. Feichtinger, gives the composition of some cements which equal English in hardening quality. The composition will be seen to approximate closely to that of the best English:—

Lime . . .	57·18	55·78
Magnesia . . .	1·32	1·62
Alumina . . .	9·20	8·90
Peroxide of iron .	5·12	6·05
Potash . . .	0·58	0·75
Soda . . .	0·70	1·06
Silica. . . .	23·36	22·53
Carbonic acid . .	1·90	1·46
Sulphuric acid . .	0·64	1·85
	100·00	100·00

The same author, in a paper "*On Winkler's Theory of the Hardening of Portland Cement,*" states his opinion that the hardening results from the formation of chemical compound of lime and silica, or lime and a silicate. In all hydraulic limes, he states, free lime is contained. He has already shown that, when Portland cement is made up with a strong solution of carbonate of ammonia, no hardening takes place, even when the excess of ammonia is washed out, in consequence of the lime becoming converted into carbonate; but if some hydrate of lime is added, the cement hardens, as well as fresh cement.

Most of the other papers are on organic chemistry, and have been already noticed.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

3. M. R. Leverson, Bishopsgate Street Within, "An improved method of treating apatite and other mineral phosphates." A communication from J. Oliver, Estremadura, Spain.—Petition recorded Jan. 2, 1865.

562. W. B. Dalston, Pittsburgh, Penn., U.S.A., "An improved atmospheric pressure lamp for the burning of benzole, paraffine, naphtha, or other volatile oils, which lamp may be used for all the purposes for which lamps are usually required, either for lighting, cooking, heating, or other purposes." Partly a communication from J. J. Riddle, Cincinnati, Ohio, U.S.A.—Feb. 28, 1865.

596. W. R. Bowditch, Wakefield, Yorkshire, "An improvement in carburetting gas, also in the preparation of hydrocarbons for carburetting gas, and improved methods of treating alkali which has been used to purify coal oils, shale oils, petroleum, and other mineral oils."—March 3, 1865.

629. T. Nicholson, Gateshead, "An improved process of, and apparatus for making caustic liquor or caustic lees."—March 6, 1865.

729. A. P. Price, Lincoln's Inn Fields, "Improvements in obtaining sulphurous acid."—March 15, 1865.

734. S. B. Boulton, Charlotte Row, London, "Improvements in the means and apparatus employed for treating timber with antiseptic or preservative fluids, also applicable to other purposes."—March 16, 1865.

Notices to Proceed.

2913. W. Ibotson, Wraysbury, Buckinghamshire, "Improvements in the preparation of pulp for the manufacture of paper."—Petition recorded November 22, 1864.

2923. F. Millus, Poole, Dorsetshire, "An improved method of cooling liquids, particularly applicable to the cooling of wort."—November 23, 1864.

2984. H. Caunter, Stornoway, N.B., "Improvements in preserving ships' bottoms and other surfaces under water, and in preventing the formation of barnacles and other accumulations thereon; which improvements are also applicable as a preservative from the effects of moisture or damp, and as a cure or preventive of the scab in sheep, and a protection to them from the effects of damp and exposure."—November 30, 1864.

3018. C. W. Siemens, Great George Street, Westminster, "Improvements in apparatus for the production, purification, and combustion of gases for heating purposes."—December 3, 1864.

3116. J. Ellis, North Ormesby, Yorkshire, "Improvements in furnaces used in the manufacture and the heating and melting of iron, which improvements are also applicable to other furnaces."—December 16, 1864.

564. J. Fordred, Blackheath, Kent, "Improvements in treating certain hydrocarbon oils, and in vessels for containing the same."—February 28, 1865.

CORRESPONDENCE.

Continental Science.

Paris, April 11.

To make bitter ales with bitter aloes is not a bad idea. It is, at all events, a safer thing to use than strychnia or nux vomica, and it may be an agreeable way of keeping people's bowels regular. It ought, however, to be distinctly understood that such a substance is employed, as, indeed, it is said to be here; and it is well to know that it is not difficult to discover aloes in an alcoholic extract of the residue obtained by evaporating the beer. The idea may be worth the attention of some English brewer. An aperient ale would, I have little doubt, go down if well advertised in the *Lancet*.

The evacuations of Mount Etna during the late eruptions have been examined with much care by an intelligent and, I may say, an adventurous chemist, M. Fouqué, who has remarked a total absence of sulphur and its compounds in them. This, which seems at first sight extraordinary, has often been observed before, as related by Humboldt in the last volume of his *Cosmos*. On no part of the lava he has been able to visit has M. Fouqué noticed the smell of sulphuretted hydrogen or sulphurous acid, nor could he get lead paper blackened. The volatilised matters which cover the blocks of lava dissolved in water gave no precipitate with chloride of barium. M. Deville has explained that sulphur emanations follow the active state of a volcano in which chlorine appears to be the predominating electro-negative element evolved. M. Fouqué has distinguished four different varieties of fumaroles—dry, acid, alkaline, and carbonic. The dry he finds on lava still incandescent; the acid, upon lava still above 400° C.; the alkaline, at a lower temperature, but yet above 100°; and the carbonic, at about the ordinary temperature. Hydrochlorate of ammonia he finds very general. It is present in the acid fumaroles, and also—but he states in very small quantity—in the dry, which he has said are situated on red-hot lava. For those of your readers who have not read Humboldt, I may quote the explanation given by Deville, that the hydrochloric acid results from the decomposition of chloride of sodium by incandescent silicates in the presence of water.

M. Dode, a provincial chemist, has introduced platinum mirrors, which are greatly admired, and which present this advantage, that the reflecting metal is deposited on the outer surface of the glass, and thus any defect in the latter is concealed. The process, which is patented here, is described as follows:—Chloride of platinum is first made by dissolving the metal in *aqua regia* and driving off the excess of acid. The neutral chloride is then dissolved in water, and a certain quantity of oil of lavender is added to the solution. The platinum immediately leaves the aqueous solution and passes to the oil, which holds it in suspension in a finely divided state. To the oil so charged the author adds litharge and borate of lead, and paints a thin coat of this mixture over the surface of the glass, which is then carried to a proper furnace. At a red heat the litharge and borate of lead are fused and cause the adhesion of the platinum to the softened glass. The process is very expeditious. A single baking, M. Dode says, will furnish 200 metres of glass ready for commerce. It would take fifteen days, he says, to coat the same extent with mercury by the ordinary plan. A reduction of from 40 to 100 per cent. in cost of looking-glass will result from the adoption of this process; for any glass, even the common bottle metal, will serve to be coated.

M. Pierre Dronier is a waiter at a café; but that has not prevented him from cultivating science, and he has devised a plan for laying a submarine cable of any weight without fear of breaking it. If I understand his idea, he intends to navigate several ships on the same vertical line, one on the surface of sea, another 2000 metres down, a third 4000 metres deep, and so on, and to drop the cable down from one to another, so letting it gently to the bottom without ever having the strain of more than 2000 metres on one break. We shall soon have drawings of the vessels and apparatus, and I will say nothing more of the plan until I see them.

Disputes with cabmen, I take it, are much more common in London than here, where, indeed, more pains are taken to prevent them. One of the most effectual of these will be some new apparatus constructed by MM. Meuley and Virdier, which shows upon two dials placed in sight of the fare the actual distance traversed by the vehicle, the time occupied in performing the journey, and lastly the time spent in waiting if any calls are made on the way.

The last number of the *Journal of Practical Agriculture* gives a very favourable account of the present state of the crops in France. The season is considered backward; but a little fine weather, it is said, will soon make up for lost time.

MISCELLANEOUS.

The Actonian Prize.—We have much pleasure in announcing that this prize of 200 guineas for the best essay on the "Phenomena of Radiation as illustrative of the Wisdom and Beneficence of the Almighty," has been adjudicated to Mr. G. Warington, F.C.S.

Letts's "Monthly Postal Almanack."—Under this title the Messrs. Letts now issue monthly a publication which will be found very useful to all having an extensive foreign correspondence.

Committee on Chemists and Druggists Bills.—On the motion of Sir F. Kelly, the select committee on the Chemists and Druggists Bills was composed of the following members:—Sir Fitzroy Kelly, Sir J. Shelley, Lord Elcho, Mr. Baring, Dr. Brady, Mr. H. Russell, Mr. C. Wynn, Mr. Ayrton, Mr. Sclater Booth, Mr. Cox, Mr. Schneider, Sir J. Fergusson, Mr. C. Forster, Mr. Roebuck, and Mr. Black. Five to be the quorum.

Royal Institution.—The following are the probable arrangements for the Friday Evening Meetings after Easter:—April 28, Professor Lyon Playfair, C.B., F.R.S., "On the Food of Man in Relation to his Useful Work." May 5, Professor Henry Fawcett, M.A., "On Wealth and those who Produce it." May 12, Frederick Field, Esq., F.R.S., "On Magenta and its Derivative Colours obtained from Coal-tar." May 19, William Huggins, Esq., F.R.A.S., "On the Physical and Chemical Constitution of the Fixed Stars and Nebulæ." May 26, H. Bence Jones, M.D., F.R.S., "On the Determination by the Spectrum Analysis of the Rate of Passage of Crystalloid Substances into and out of the Tissues of the Living Body." June 2, Professor Huxley, F.R.S., "Ethnological subject." June 9, Professor Frankland, F.R.S., "Latest Researches in Organic Chemistry." The Friday arrangements depend in great measure on the free kindness of eminent men, whose time is subject to the sudden claims of public or professional duty. They are, therefore, liable to change.

ANSWERS TO CORRESPONDENTS.

Mr. A. H. Church's communication shall appear in our next,

Subscriber.—They are not at present articles of commerce, but might, we think, be produced at no great cost. Apply to some operative chemist.

G. M. E.—We know of no separate work on the subject, but you will find all necessary information in the last edition of Ure's Dictionary.

Books Received.—"Practical Chemistry," by Dr. Stevenson Macadam. "Notes on the Manufacture of Sugar," by C. A. Goessmann. "Nitrogen shown to be Carbonic Oxide in an Allotropic State," by Henry Kilgour.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

An Introduction to Chemical Philosophy, according to the Modern Theories, by ADOLPHE WURTZ, *F.R.S.*

PART I.

EQUIVALENTS, ATOMIC WEIGHTS AND MOLECULAR WEIGHTS.

SECTION II.—*New System of Atomic Weights.*

(*Continued from page 170.*)

II. PHOSPHORUS, arsenic, mercury, and cadmium are exceptions to the preceding rule. The weight of two volumes of vapour of phosphorus or arsenic (the double density as compared with hydrogen) represents, not two atoms, but four atoms of phosphorus or arsenic. The weight of two volumes of mercury or cadmium vapour represents not two atoms, but one atom of mercury or cadmium.

It may be asked if these exceptions are due to some anomaly, or to some error in the determination of the atomic weights? In our opinion the former is the true interpretation. The well-recognised analogy between nitrogen, phosphorus, and arsenic leaves no doubt as to the true atomic weight of these elements. Two volumes of ammoniacal gas combine with two volumes of hydriodic acid to form hydriodate of ammonia. Two volumes of phosphuretted hydrogen combine with two volumes of hydriodic acid to form hydriodate of phosphuretted hydrogen. Two volumes of ammoniacal gas are, therefore, equivalent to two volumes of phosphuretted hydrogen; and if two volumes of ammoniacal gas represent one molecule containing one atom of nitrogen, two volumes of phosphuretted hydrogen represent one molecule containing one atom of phosphorus. If ammonia is NH_3, phosphuretted hydrogen and arseniuretted hydrogen are PH_3 and AsH_3, and not $P_{\frac{1}{2}}H_3$ and $As_{\frac{1}{2}}H_3$. These latter formulæ correspond with the abnormal vapour density of phosphorus and arsenic. Everything now proves that these must be rejected and the former adopted. It follows, therefore, that in their combinations with hydrogen (and, we may add, with chlorine, bromine, iodine, and organic radicals), phosphorus and arsenic have the normal vapour density which would be in harmony with Ampère's law. That follows from the figures given in the table on page 158, where the molecular weights of the volatile combinations in question deduced from the true atomic weights (31 and 75) are identical with their double densities compared with hydrogen.

Mercury, cadmium, and doubtless zinc exhibit a contrary anomaly in their vapour-densities: their molecules are the same as their atoms; for the weight of two volumes of mercury vapour = 200, which ought to be the molecular weight, is really the atomic weight, deduced from the specific heat and chemical considerations; and what proves that this is true atomic weight is the fact that it agrees with the molecular weights of a large number of volatile mercurial compounds, as deduced from their vapour-densities. (See the table at page 159.)

The same anomaly, if anomaly there be, is seen also in some organic radicals, comparable with mercury and cadmium. This deserves a word of explanation.

When iodine separates from the ethyl in iodide of ethyl, an ethylic group takes the place of the iodine in the iodide, and combines with the other ethylic group, so as to constitute free ethyl, which occupies exactly the same volume as the iodide of ethyl in a state of vapour.

$\boxed{\ I \mid C_2H_5\ }$	$\boxed{C_2H_5 \mid C_2H_5}$
2 vols. of iodide of ethyl.	2 vols. of ethyl.

But when bromine separates from the ethylene in the bromide of ethylene, the radical ethylene set at liberty, instead of combining with another radical ethylene, dilates and occupies the space before taken up by the bromide of ethylene.*

$\boxed{Br_2 \mid C_2H_4}$	$\boxed{\ C_2 \mid H_4\ }$
2 vols. of bromide of ethylene.	2 vols. of ethylene.

In the same way, when bromine separates itself from the mercury in mercuric bromide, the mercury set at liberty, instead of uniting with itself like ethyl, expands like ethylene, so as to occupy the whole space filled by the bromide of mercury.†

The compound radicals, ethylene, propylene, &c., to which we can add carbonic oxide,‡ are, then, in this respect comparable to the diatomic metals, mercury, cadmium, and zinc. Between the molecular formula of ethylene and that of ethyl there exists the same difference as that we find between the molecular formula of mercury and that of hydrogen or oxygen. The smallest quantity of these radicals which exists in a compound and which corresponds to one atom is the same as the smallest quantity which exists in a free state and represents a molecule. The foregoing is not an explanation; it is only a comparison; but in estimating the anomaly which the vapour-density of certain metals present, we must take into account such anomalies as we have quoted.§

It only remains to add a few words in order to demonstrate that the atomic weights which it is proper to adopt for certain simple bodies are confirmed by the vapour-densities of their volatile compounds. This will be seen on referring to the table given at page 158, which shows:—

1. That the vapour-densities of the volatile compounds of carbon, silicium, and boron, leave no doubt as to the atomic weights which must be attributed to these bodies.

If two volumes of hydrogen weigh 2, two volumes of chloride of silicium contain 28 of silicium; two volumes of chloride of carbon contain 12 of carbon; two volumes of chloride of boron contain 11 of boron.

So vanish the doubts which the law of Dulong and Petit might leave relative to the atomic weights of carbon, boron, and silicium.

2. The table shows that the vapour-densities of the volatile compounds of aluminium, iron, chromium, zirconium, tin, titanium, bismuth, zinc, lead, and mercury demonstrate that the atomic weights of these metals are double the equivalents now received, and are the same as the atomic weights of Berzelius, and thus deduced from the law of Dulong and Petit.

If two volumes of hydrogen weigh 2:—

Two volumes of stannic chloride contain 118 of tin;

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* $\left.\begin{matrix} C_2H_4Cl_2 = 99 \\ C_2H_4 = 28 \end{matrix}\right\}$ See table at page 159.

† $\left.\begin{matrix} HgCl_2 = 1 \text{ molecule} = 271 \\ Hg = 1 \text{ molecule} = 200 \end{matrix}\right\}$ See table at page 159.

‡

$\boxed{Cl_2 \mid CO}$	$\boxed{\ C \mid O\ }$
2 vols. of chloride of carbonyle.	2 vols. carbonic oxide.

§ Our present notions of the atomicity of carbon, which we shall develop presently, allow us to conceive the existence of an unsaturated molecule $\overset{\prime\prime}{C}{}_2H_4$ = 2 vols. in which one atom of carbon is diatomic and the other tetratomic. When the vapour of mercury expands in giving up the bromine of the bromide (in which mercury plays the part of a diatomic element) it would seem that the metal becomes monatomic, and that its vapour is then formed of two atoms $\boxed{Hg' \mid Hg'}$ = 200.

Two volumes of chloride of titanium contain 50 of titanium;

Two volumes of chloride of zirconium contain 89·6 of zirconium;

Two volumes of zinc ethyl contain 65·2 of zinc;

Two volumes of mercuric chloride contain 200 of mercury;

Two volumes of ferric chloride contain 2 × 56 of iron =2 atoms;

Two volumes of chloride of aluminium contain 2 × 27 of aluminium = 2 atoms.

In fact, with the exceptions of ferric chloride and chloride of aluminium, to which we shall return, we have no reason to suppose that two volumes of the volatile compounds mentioned contain more than one atom of metal. The numbers given thus express the atomic weights, and it is easy to see that they are double the equivalents at present admitted.

(To be continued.)

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*On the Calorific Phenomena which Accompany the Formation of Organic Compounds,** by M. BERTHELOT.

(*Concluded from page 171.*)

III. Aldehydes.—That the change of alcohols into aldehydes by oxidation gives rise to a disengagement of heat, is an everyday observation, but I know only one measure of the reaction. Acetone represents the aldehyde of propylic alcohol:

$$C_6H_8O_2 + O_2 = C_6H_6O_2 + H_2O_2.$$

The combustion of the second system, however, produces 424 units of heat, and therefore that of the first should produce 476. The heat disengaged in the transformation of this alcohol into aldehyde is 52; this is less than a fourth of that disengaged in the formation of the same quantity of water from free hydrogen (69). The inverse reaction, the change of acetone into propylic alcohol, $C_6H_6O_2 + H_2 = C_6H_8O_2$, disengages 17 units.

IV. Acids.—Let us review the principal reactions by which organic acids are formed:—

1. *Oxidation of Alcohols.*—Acetic acid from ordinary alcohol,

$$C_4H_6O_2 + O_4 = C_4H_4O_4 + H_2O_2.$$

Heat disengaged 111.

Valerianic acid $C_{10}H_{10}O_4$ from amylic alcohol, 131.

Formic acid $C_2H_2O_4$ from methylic alcohol, 74. This last number is lower than the others in consequence of the anomaly already noticed relative to formic acid.

We see by the above that the heat disengaged by the union of four equivalents of oxygen with ordinary alcohol and with amylic alcohol is scarcely less than that disengaged by the same amount of oxygen with free hydrogen (138).

The numbers quoted represent equally the work necessary to change an acid into an alcohol by reduction.

The heat disengaged in the formation of acids from alcohol results from two consecutive effects; combustion of hydrogen (aldehyde stage), addition of oxygen (acid). These two stages would disengage nearly the same amount of heat, if it was proved that the formation of ethylic aldehyde answered to 52, the number found in the case of acetone.

The above numbers may also be in accordance with the results of the oxidation of ethylenic carbides,—

$$C_4H_4 + O_2 = 65(?) C_4H_4 + O_4 = 124.$$

or with those of the formic carbides,

$$C_4H_6 + O_8 = C_4H_4O_4 + H_2O_2 = 155.$$

Thus O_8 fixed upon C_4H_6 disengages thrice the amount disengaged in fixing O_2 upon $C_4H_6O_2$ (52).

A more profound oxidation of alcohol begets acids with 8 equivalents of oxygen. Oxalic acid

$$C_4H_6O_2 + O_{10} = C_4H_2O_8 + 2H_2O_2.$$

Heat disengaged $= 264, \frac{264}{5} = 53$ corresponding to O_2.

This oxidation may be in relation with that of a formenic carbide,—

$$C_4H_6 + O_{12} = C_4H_2O_8 + 2H_2O_2 = 305, \frac{305}{2} = 152.$$

We thus see that the two consecutive and symmetrical reactions which produce the one acetic and the other oxalic acid by means of a formenic carbide would disengage almost the same quantity of heat.

2. *Fixation of Carbonic Oxide upon Alcohols.*

Acetic acid $C_2H_4O_2 + C_2O_2 = C_4H_4O_4$.

Heat disengaged = 29.

Propionic acid $C_2H_6O_2 + C_2O_2 = C_6H_6O_4$.

Heat disengaged = 37.

Valerianic acid $C_{10}H_{10}O_4$. Heat disengaged = 43.

All these quantities are larger than those produced by the union of carbonic oxide with free oxygen (25).

If the reactions were referred to formic acid instead of carbonic oxide, it would be necessary to add 36 to the foregoing numbers.

3. *Fixation of Carbonic Acid upon Carbides of Hydrogen.*—Acetic acid $C_2O_4 + C_2H_4 = C_4H_4O_4$. Heat inappreciable.

In reality, there ought to be an absorption of heat in the atomic reaction, since the two gases are transformed into a liquid compound—a physical effect which gives rise to an absorption of heat; but I only reason upon the *actual state* of the systems.

This result, which agrees with my observations relative to formic acid, appears to change in sense in the case of the more condensed acid; valerianic acid

$C_2O_4 + C_8H_{10} = C_{10}H_{10}O_4$. Heat disengaged = 18.

Here are the reciprocal effects to which the separation of carbonic acid gives rise: at the expense of formic acid it is accompanied by a disengagement of heat; at the expense of acetic acid the disengagement should be *nil*, and at the expense of valerianic acid there will be absorption of heat.

V. Ethers.—The combination of mineral acids with alcohols gives rise to well-marked calorific effects, as may be easily observed with hydrochloric, sulphuric, and nitric acids. But in the case of organic acids the phenomena are less distinct; experiment proves this directly, and the heats of combustion of ethers confirm it.

The differences in the heat disengaged in the formation of ethers correspond to analogous differences in the work necessary to decompose them. Thus the splitting up of nitric, sulphuric, and hydrochloric ethers is often more difficult to accomplish than that of the organic ethers, and gives rise sometimes to different products; simple ether or carbide instead of an alcohol, ethylamine in place of an amide, &c., &c.

It is no doubt for this reason that the equilibrium of etherification is sensibly within the same limits for the various organic alcohols and acids, while the limits are very different for the mineral acids. Hence, it may be, the part, hitherto unexplained, that mineral acids play in favouring the etherification of organic acids. Hence, perhaps, the production of organic ethers in the presence of free hydrochloric acid, as in the reaction of acid chlorides upon an alcohol. Under all these conditions, we see produced at first and by preference the ether, the

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* *Comptes Rendus*, t. lx., p. 485.

formation of which corresponds to the lowest calorific change—that is to say, the least change in the molecular state of the initial compounds.[†]

If we examine more precisely the formation of organic ethers, we find that the heats of combustion *of all the observed ethers*, with the exception of the formic ethers, are in excess of the sum of heats of the alcohol and the generating acid; the difference sometimes rises to $\frac{1}{16}$th—a singular circumstance, which it appears to me difficult to attribute to errors of experiment.[‡] These facts would tend to establish the existence of a negative work beyond the transformation of the alcohol and acid system into the ether and water system *taken in its actual form*. Ought this negative work to be attributed to the atomic combination or to physical changes which supervene in the arrangement of molecules? The second explanation appears to me the more probable.

We come now to the ethers formed by the union of two alcohols: I will quote that of ordinary ether and ethylamylic ether.[§] The heat of combustion of ordinary ether—

$$C_4H_6O_2 + C_4H_6O_2 = C_8H_{10}O_2 + H_2O_2 = 668,$$

an amount very near that of the generating alcohol (660), according to Favre and Silbermann. But Dulong gives a number considerably higher (698), which better agrees with the analogies of compound ethers. In the same way ethylamylic ether produces 1161, and its generators 1109. The formation of mixed ethers, then, as well as organic ethers seems, to be accompanied by an absorption of heat. This circumstance is conformable with the necessity of a double decomposition producing by a simultaneous reaction the work necessary for the formation of these ethers.

It will be remarked that in the formation of mixed or compound ethers, the production of the water which is eliminated is not in general accompanied by a disengagement, as would happen if this formation answered to an oxidation. On the contrary, it will rather be correlative with an absorption of heat.

VI. Amides.—We have only data for one carbonated amide, cyanogen, as derived from oxalic acid—

$$C_4H_2O_8,2NH_3 = C_4N_2 = 2H_2O_2.$$

The heat of combustion of cyanogen = 270, a number much higher than that of oxalate of ammonia, about 175.[‖]

Thus, in the transformation of oxalate of ammonia into cyanogen, not only is the production of water unaccompanied by the disengagement of heat, but there is a considerable absorption of heat, analogous to that mentioned in the case of the mixed ethers. Reciprocally the fixation of water upon ether and cyanogen gives rise to a disengagement of heat.

It would, no doubt, be premature to extend this result to all the amides. I cannot, however, avoid noticing the interest these phenomena may present in the animal organisation, in which nitrogenised bodies of the amide order constitute the greater part of the tissues, in which the fatty bodies are so widely scattered, and in which the reactions of hydration are neither less frequent nor less important than the reactions of oxidation.

On the Influence of Quantity of Matter over Chemical Affinity, as shown in the Formation of Certain Double Chlorides and Oxalates, by GEORGE RAINEY, M.R.C.S.

THE simple fact that quantity of matter has the effect of influencing chemical affinity is so well known and so generally admitted that any special remark upon it would be superfluous. I shall, therefore, in this communication chiefly confine my observations to the compounds above named, by which this effect will be shown to be strikingly exemplified, offering such explanations and remarks thereon as the nature of the facts may seem to demand.

The results of nearly all the experiments mentioned in this paper were first arrived at by operating upon very minute quantities of material and by observing under the microscope the changes that take place; but afterwards the same products were obtained on the large scale by appropriate processes, and in quantities sufficiently large to admit of being analysed quantitatively and of having their formulæ accurately determined. I shall therefore commence by giving an account of the processes by which the various compounds I am about to treat of can be most easily prepared in minute quantities, and afterwards those by which they can be formed in any quantity that may be required.

All the apparatus necessary for the preparation of these compounds in quantities sufficient for microscopical examination are a few cells, made by cementing a ring of thin glass, such as is ordinarily used by microscopists, and some circular discs of thin glass to be employed as covers. The cell must be sufficiently shallow to allow of the examination of its contents with a lens of a half or quarter of an inch focus.

To prepare the compound of oxalate and chloride of strontium, introduce into a cell a few crystals of oxalate of strontia, and add to them as much saturated solution of chloride of strontium as will completely fill the cell; then cement upon the cell a thin glass cover in such a way that the cell shall be completely air-tight. A cell thus charged must be kept in a horizontal position, and examined from time to time. In a few hours the angles and edges of the oxalate of strontia crystals will be observed to have lost their sharpness of outline, being in a state of disintegration, and very minute crystals, altogether of a different form from those of the oxalate, to have made their appearance; and on successive examinations all the octahedral crystals will be seen to have disappeared and to have become replaced by exceedingly well formed rhomboidal crystals of different sizes, composed of the two salts introduced into the cell. In this experiment the solution of the chloride of strontium must be fully saturated; and if it even contain a few undissolved crystals, the processes of disintegration of the oxalate and formation of the compound will be prolonged, and more time allowed for their microscopical examination.

If, in the place of oxalate of strontia and chloride of strontium, crystals of oxalate of lime and a strong solution of chloride of calcium be introduced into a microscope cell, and the cell be closed up, the crystals of this oxalate (like those of the oxalate of strontia) will be seen by the microscope to become gradually disintegrated and replaced by an entirely different set of crystals, consisting of oxalate of lime and chloride of calcium. In this experiment either the oxalate made artificially or that obtained from any natural source may be employed; but the strength of the solution of the chloride of calcium must not be less than that of a

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[†] By prolonged contact the inverse change may be observed in some cases.

[‡] The exception of the formic ethers may be regarded here as confirming the rule.

[§] I suppose that this is the body studied by Favre and Silbermann under the name of amylic ether.

[‖] The carbon of cyanogen if free would produce 188, an amount lower than 270; cyanogen, then, is a body resolvable into its elements with disengagement of heat, like protoxide of nitrogen and hypochlorous acid.

mixture consisting of equal parts by measure of a solution of this chloride saturated at a temperature of 60° Fahr. and water. The time required for the disintegration of all the oxalate of lime and its combination with the chloride of calcium to form crystals of the double compound of these salts depends upon the size of the crystals of oxalate of lime employed in the experiment. If they are very small, or if the oxalate is to all appearance amorphous, evidence of these changes will be visible in a few hours and the crystals completely formed in a few days; whilst if the oxalate crystals are large and well formed, some weeks will elapse before they have entirely disappeared and become replaced by the new crystals.

These changes are also influenced by the strength of the solution of the chloride of calcium; if it be fully saturated they take place more quickly, but the crystals will be small; if diluted, they will, on the contrary, be produced more slowly, and the crystals will be larger and better defined. Crystals of oxalate of magnesia put into a cell with a saturated solution of chloride of magnesium undergo similar changes, a double salt, consisting of oxalate of magnesia and chloride of magnesium, being formed. In this case the changes take place very slowly, several months being required for the formation of perfect crystals. These crystals have their sides and angles exceedingly sharp and well defined. Lastly, the oxalate of baryta and a saturated solution of the chloride of barium placed under the conditions above mentioned yield the same results, and crystals of oxalate of baryta and chloride of barium are formed.

The series of facts requiring notice in the process of formation of these double salts, as shown in the foregoing experiments, are, first, the disintegration, and at length complete dissolution, of a class of salts of very sparing solubility in strong solutions of chlorides of the same base, whilst weaker solutions do not in the least affect them; secondly, the combination under these circumstances of the oxalate and chloride of these bases to form double salts almost as little soluble as the simple oxalates; and lastly, the continued and simultaneous solution and deposition of these salts in a crystalline form in a quantity of fluid but little, if at all, exceeding the weight of the crystals deposited, until either all the oxalate crystals employed at the commencement are used up or the solution of the chloride has become too feeble to effect the further disintegration of those which are in excess. The most remarkable part of this process is the continued deposition of crystals after the saturation of the fluid in which they were formed, rendering a small portion of fluid sufficient for the production of a comparatively large quantity of crystals. This fact seems to indicate that in this case the newly-formed particles, immediately on their coming into existence in this fluid medium, are attracted more forcibly by the fluid than by one another, but that afterwards, when they have become augmented to a point above that which is said to be the point of saturation, their attraction for one another becomes greater than that for the fluid with which they are in contact; and being thus brought within the sphere of action of the forces necessary to produce crystals, these particles combine into the crystalline form.

Whether under conditions like the above a deposition of crystals is a necessary attendant on the formation of sparingly soluble substances in a fluid medium it is not possible to say, but in the course of these investigations I shall be able to adduce several other examples of a similar kind.

The experiments which have been related so far have gone only to exemplify the influence of quantity of matter on chemical affinity as connected with simple chemical combination; but by a slight modification of these experiments the effect of the same principle on elective affinity can be demonstrated. For this purpose let a small quantity of oxalate of lime, either amorphous or crystalline, be introduced into a microscope cell filled with a completely saturated solution of chloride of strontium, and securely closed up. On examining such a preparation, the oxalate of lime is seen in a few days to be undergoing disintegration, and new crystals are seen to make their appearance, generally first at the sides of the cell. These crystals being formed slowly have a very sharp outline, and are remarkably transparent. In their form they resemble those obtained by putting oxalate of strontia into a saturated solution of the chloride of strontium; and notwithstanding that many of them have some of their angles cut off, and are thus made to present additional sides, their composition is precisely the same as if oxalate of strontia had in this instance been acted upon by a saturated solution of chloride of strontium. As in this experiment a chloride of calcium is formed at the expense of some of the chloride of strontium, the solution soon becomes too feeble to decompose the oxalate of lime, when of course the further formation of crystals will cease. Hence, to secure the best results, some crystals of chloride of strontium must be undissolved in the solution when put into the cell. By this means the processes of disintegration and the production of new crystals can be prolonged for many months, and an opportunity is thereby afforded of measuring them and of determining their rates of increase, or of making such other observations on the subject as the experiment may suggest.

The methods of forming the double compounds of the oxalates and chlorides of the alkaline earths in microscopical quantities having thus been described, it now remains to show how, on the same principle, these compounds can be formed on the large scale.

To prepare the double salt consisting of oxalate of strontia and chloride of strontium, it is necessary merely to mix oxalate of strontia (made by decomposing the oxalate of ammonia by chloride of strontium, and washing the precipitate by decantation, and not on a filter) with a solution of chloride of strontium kept at the point of complete saturation. In order that no lumps of oxalate may be mixed with the solution of the chloride, which would be unavoidable if any portion of the oxalate had been allowed to get dry, it is necessary, after finally washing the oxalate, to draw off as much of the water as possible with a syphon, and to add to the mixture of the oxalate of strontia and remaining water the saturated solution of chloride of strontium containing some undissolved chloride. If the solution of the chloride of strontium in which the oxalate is contained is fully saturated, the combination will begin in a few hours; but it will require two or three weeks before all the oxalate has combined with the chloride. This can be determined only by the microscope.

The double salt of oxalate of lime and chloride of calcium can be formed in the same manner. In the formation of this compound it is not necessary that the solution of the chloride of calcium should be fully saturated; and the weaker the solution of this chloride is, provided only it is of sufficient strength to combine with the oxalate, the larger will be the crystals of the double salt.

Since writing the above, I find that the same double compound of oxalate of lime and chloride of calcium has been prepared by Fritsche by a different process.—*Proceedings of the Royal Society.*

The Transformation of Nitrous Oxide (Protoxide of Nitrogen) into Nitric Acid and Ammonia (the Binary Compounds from which it is Formed), by M. J.* Persoz.

The molecule of nitrous oxide is more complex than has been hitherto supposed, and it should contain, besides the latent heat which maintains it in a gaseous state, a certain amount of heat accumulated in the molecule, giving it, at least in part, the properties which characterise oxygenated water, certain oxides and peroxides, and finally several acids, which, in their molecular movements disengage a superabundant amount of heat, the theoretical cause of which cannot always be defined.

Its *double* molecule N_2O_2 becomes, in fact, comparable to that of many of these compounds. As it then represents all the elements of ammonic nitrate, minus four equivalents of water, we must conclude that if it were possible under these circumstances to make water react on this molecule, we should regenerate nitric acid and ammonia in the same way that M. Pelouze, in his beautiful experiment on hydrocyanic acid, transformed this body into formiate of ammonia and *vice versa.*

The following experiment seems to us fully to bear out this opinion:—

Take a retort, about 125 cubic centimetres in size, pour into it nearly 50 grammes of fused nitrate of ammonia; to the neck of the retort adjust a small tubular receiver destined to condense the greater part of the water proceeding from the decomposition of the salt, and, by means of a tube, place this small condenser in communication with a combustion tube, bent slightly in the centre to keep the matter fused in that part of the tube. Fill about 15 or 20 centimetres of the length of the latter with a mixture of potassic hydrate and fragments of quick lime, to give freer access to the gas. Heat this tube to near dull red heat, and then pass the gas produced by the decomposition of the nitrate of ammonia, which is simply *nitrous oxide* gas charged with aqueous vapour. The current of gas being established, and the tube gradually heated, an abundant disengagement of ammonia takes place, recognisable by its odour and by its action on test papers.

If, after having maintained the disengagement of ammonia for a certain time, the experiment is brought to a close, the saline mass remaining in the combustion tube washed with water; if this liquid is saturated with chromic acid, evaporated to dryness, heated to red heat, and the residue mixed with twice its weight of potassic bichromate, abundant nitrous vapours will be disengaged, indicating the presence of nitric acid. This result leaves no doubt as to the possibility of transforming nitrous oxide (protoxide of nitrogen) into ammonia and nitric acid.

New Green Pigment.—Under the name of "Green Cinnabar," Vogel describes a new colour which is prepared in the following way:—Prussian blue is dissolved in oxalic acid; chromate of potash is added to this solution, which is then precipitated with acetate of lead. The precipitate, well washed, dried, and levigated, gives a beautiful green powder. By varying the proportions of the three solutions, various shades of green may be procured. Chloride of barium or nitrate of bismuth may be used in place of sugar of lead.—*Chem. Central Blatt.* [Another mode of preparing this colour will be found at page 182, vol. ix. Chemical News.]

TECHNICAL CHEMISTRY.

On Ancient Mortars, by William Wallace, *Ph.D., F.R.S.E., F.C.S.*

Having, by the kindness of William Clarke, Esq., C.E., who has recently returned from the East, been supplied with specimens of mortars and plasters from well-known ancient buildings in Egypt, Greece, Italy, and the Island of Cyprus, I have submitted a number of them to analysis, with the object of determining several points of interest. The ages of the mortars vary from about 1600 to upwards of 3000 years, thus dating back to the most ancient historical periods. I propose in the present notice to give the results of the analysis of such of the specimens as I have examined.

Mortar of the Great Pyramid.—Two specimens of mortar from the Pyramid of Cheops were examined, one being from the interior and the other from the outside of the structure. That from the interior was from the great chamber or the passage leading to it. Both specimens present the same appearance—that of a mixture of plaster of a slight pinkish colour, with crystallized selenite or gypsum. They do not appear to contain any sand, the silicic acid being evidently in combination with alumina as clay. Part of the selenite was probably burnt, and the result mixed up with burnt lime, ground chalk, or marl, and coarsely-ground selenite. The latter would act the part of sand in our mortars—*i. e.*, prevent undue contraction in drying. The quantity of water is almost exactly what is required to form the ordinary hydrate of sulphate of lime with 2 equivalents of water. The mortar is easily reduced to fragments, but possesses a moderate degree of tenacity. Professor C. Piazzi Smyth, who is at present making explorations in the pyramid, and to whom I have communicated the results of my analysis, has informed me that large quantities of gypsum and alabaster are found in its vicinity; and that some enormous slabs of alabaster or selenite have been discovered lining the walls of a large tomb recently opened. The material of which the pyramid itself is constructed being limestone, there is no difficulty in accounting for the presence of the lime.

	Interior.	Exterior.
Sulphate of lime, hydrated . .	81·50†	82·89†
Carbonate of lime (CO_2 calculated) .	9·47	9·80
Carbonate of magnesia (do. do.) .	·59	·79
Oxide of iron	·25	·21
Alumina	2·41	3·00
Silicic acid	5·30	4·30
	99·52	100·99

Ancient Phœnician Mortars from Cyprus.—Two specimens were obtained from Cyprus. The first is from the ruins of a temple near Larnaca, the highest stone of which, at present remaining, is five feet below the level of the ground, and the lowest about eighteen feet. Mr. Clarke supposes this to be the most ancient mortar in existence, and it certainly is one of the best I have ever seen. It is exceedingly hard and firm, and appears to have been made of a mixture of burnt lime, sharp sand, and gravel, some of the fragments being about half-an-inch diameter. On solution in hydro-

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* *Comptes Rendus*, lx., 441.

† Water by actual estimation, 16·66, 17·38.

chloric acid, it gave a small quantity of soluble silica, amounting to ·52 per cent.

The other specimen from Cyprus is a cement used for joining water pipes. These pipes were found near Larnaca ten feet below the surface of the ground, and bear evidence of extreme antiquity; they are of red clay, about eleven inches diameter, and are connected by spigot and fawcet joints, the intervening spaces being filled with the cement and afterwards coated with a black substance which was found to be bitumen. This mortar or cement is very hard, and perfectly white in colour. It will be observed that in both of these Phœnician mortars the lime is almost completely carbonated.

	Temple.	Cement.
Lime	26·40	51·58
Magnesia	·97	·70
Sulphuric acid	·21	·82
Carbonic acid	20·23	40·60
Sesquioxide of iron	·99	—
Alumina	2·16	·40
Silicic acid and fine sand	16·20	·96
Coarse sand	3·37	—
Small stones	28·63	—
Organic matter	·56	·24
Water	·54	3·09
	100·26	98·39

Ancient Greek Mortars.—The first specimen is taken from a part of the Pnyx, the platform from which Demosthenes and Pericles delivered many of their orations. It has been long exposed to the action of the weather, is very hard, and of a greyish white colour. The other specimen is plaster from the interior of an ancient temple at Pentelicus, near Athens. It has not been exposed to the weather, the temple being in a cave; it is of a pale cream colour, and moderately hard. The analytical results are the following:—

	Pnyx.	Temple at Pentelicus.
Lime	45·70	49·65
Magnesia	1·00	1·09
Sulphuric acid	—	1·04
Carbonic acid	37·00	38·33
Sesquioxide of iron	·92	·82
Alumina	2·64	·98
Silicic acid and sand	12·06	3·90
Water	·36	3·07
	99·68	98·88

In the mortar from the pnyx the carbonic acid is exactly the amount required by the lime and magnesia, supposing both to be completely carbonated; in that from the temple the carbonating is nearly, but not quite complete.

Ancient Roman Mortars.—These differ from those already mentioned in being evidently prepared by mixing with burnt lime, not sand, but puzzeolana, or what is commonly, although improperly, called volcanic ash. Of these four specimens were examined, but two only of the analyses were completed, owing to deficiency of material. The first in the following table was taken from Adrian's Villa at Tivoli, near Rome; it is a tolerably hard and firm mortar, of a rather dark grey colour.

The second is plaster from the interior surface of a wall at Herculaneum; it is hard, evidently exposed on one side to the action of hot volcanic mud, and of a red tint. The third specimen is from the roof of the Latin tombs near Rome, of a pale reddish-brown colour. The fourth is a cement or mortar from a mosaic forming the floor of the baths of Caracalla, Rome. All these mortars were hard and firm, and contained an appreciable amount of silicic acid in combination:—

	Adrian's Villa.	Herculaneum.	Latin tombs.	Mosaic.
Lime	15·30	29·88	19·71	25·19
Magnesia	·30	·25	·71	·90
Potash	1·01	3·40	not estimated	
Soda	2·12	3·49	not estimated	
Carbonic acid	11·80	23·80	13·61	17·97
Peroxide of iron	4·92	2·32	1·23	3·67
Alumina	14·70	2·86	16·39	10·64
Silicic acid & sand	41·10	33·36	36·26	30·24
Organic matter	2·28	1·50	...	2·48
Water	5·20	1·00	8·20	5·50
	98·73	101·86		

General Remarks.—These analyses appear to show that the lime in mortars and plasters becomes in the course of time completely carbonated, and does not form a combination consisting of $CaO,HO + CaO,CO_2$, a conclusion that has been arrived at by some authorities. They also show that in all cases where the mortar is freely exposed to the weather, a certain proportion of alkaline or earthy silicate is formed, which in all probability confers additional hardness, and that those mortars are the hardest which have been long below ground. It is well known to builders that those walls are strongest that are built during a rainy season, and that when mortar dries quickly it becomes crumbly and possesses little binding power. When kept wet for some time, a small proportion of silicate of lime will be formed, which will not only make the mortar itself harder, but will unite it more firmly with the stone. It is curious that the mortar which is probably the most ancient (the specimen from a Phœnician temple) is by far the hardest and firmest, in fact, like a piece of rock. It is a concrete rather than a mortar, and its excellence seems to indicate that a large grained sand is best for building purposes, and that even small gravel may, in certain cases, be used with advantage.

Mechanics' Institution, Glasgow.

PHYSICAL SCIENCE.

*On the Application of Spectrum Analysis to Microscopical Investigations, and especially to the Detection of Blood-stains,** *by* H. C. Sorby, *F.R.S., &c.*

Since various substances may appear to have the same colour, and yet act very differently on the spectrum, or, on the contrary, may give the same characteristic spectrum, and yet differ materially in colour, it is in all cases desirable to study them by means of the prism. As is well known, this method has been employed with remarkable success in various branches of science; but, so far as I am aware, has not hitherto been applied to microscopical inquiries. In order to accomplish this, I have made a number of experiments, and at length contrived an arrangement which, so far, has answered every purpose required of it. I have also discussed the various particulars with my friends, the Messrs. Beck, who intend to adapt a similar arrangement to their microscopes, and we cannot perceive how any considerable alteration could be made with advantage, except such as would be required in the case of microscopes of different construction. I shall therefore describe what I have adapted to my own, one of their large binocular microscopes.

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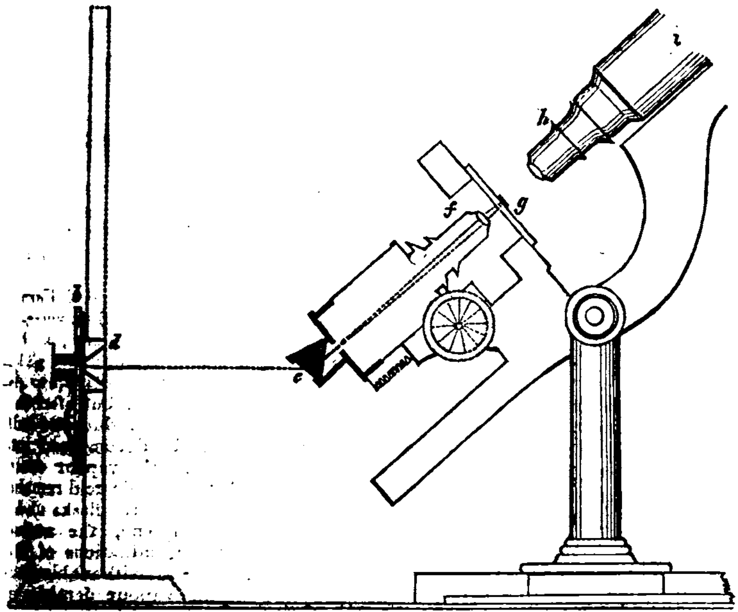
* From the *Quarterly Journal of Science.*

The general construction will be more readily understood by reference to the accompanying Figure:—

SPECTRUM MICROSCOPE.



The only addition to the microscope itself is the prism (*e*) and its mounting, shown by the dark lines. This fits into the bottom of the moveable tube carrying the achromatic condenser (*f*). Detached from the microscope is a long narrow slit, shown in section at (*b c*); and the light passing through this at (*a*) is separated by the prism (*e*), and passes on to (*g*), where the image of the slit is seen as a coloured spectrum, on looking through the microscope in the usual manner. By this arrangement we can determine the character of the light transmitted by an object placed on the stage at (*g*), or by one held in front of the slit at (*a*); and, by a little adjustment, we can compare the two spectra side by side.

Having thus given a general account by way of introduction, I will now describe the apparatus in detail.

The slit is made of two brass plates about six inches long and one inch broad. The lower has two strips of brass fastened at each end, between which the other plate fits, so that it may be moved up and down, and fastened by means of screws, which clamp together the upper part of the strips. The edges of the plates, thus brought together, are made quite straight and bevelled, so that by putting a small piece of thin writing paper at each end, pressing down the upper plate, and fixing it with the screws, an opening is left between the plates five inches long and about $\frac{1}{100}$th of an inch wide. The lower plate carries a small arm, fitting into a tube attached to a stand (shown by the dotted lines), such as is employed to hold a bull's-eye condenser, so that the slit is always horizontal, and that we may vary its height from the bottom of the stand, and the inclination of the face of the plates. Then, since it is often requisite to hold different sorts of objects in front of the slit, a piece of brass, to act as a stop, carrying a spring, is fixed on one side, as shown at (*c*), so that a square piece of glass can be held in the same position, or moved up and down directly in front of the slit. In the figure the plates of brass are shown by the black portion (*b c*), the glass by the unshaded part on the left side below (*b*), whilst the shaded part at *a* represents a small narrow tube into which any liquid may be put for examination. Large crystals or other objects mounted on plates of glass may also be held in the same manner. In some cases it is desirable to examine solutions held in test-tubes. For this purpose two pieces of wood are fixed on the other side of the brass plates, shown in section at (*d*), extending the whole length, and even projecting beyond them at each end. They are made in the V form shown in the figure, so that whether the tube be small or larger, its centre may be directly in front of the slit; and wood is better than brass when it is desirable to examine hot solutions. Towards each end is a spring, so that two tubes may be held, and the spectra of the liquids they contain compared. Of course all parts of these fittings must be a good, dead black. I have covered the brass with black silk, which cannot be scratched by the glasses, fastening it down with liquid india-rubber.

Since it is often desirable to have a narrow spectrum, a prism of crown-glass is better than one of flint-glass; and, when a broader spectrum is required, it can be readily obtained by using a condenser of longer, or an object-glass of shorter, focal length. The prism should be fixed in the position shown at *e*, so that the light may enter at *a e*, and pass off at *e g*, at about equal angles. With crown-glass the front face (*e*) should, therefore, be inclined at about 10° to the axis of the microscope. The prism might be fitted just within the tube of the condenser; but I have fixed it as shown, so that a large Nicol's prism may be inserted above it, to be used as described in the sequel. For some purposes day-light must be used, especially when it is desirable to have the blue end of the spectrum well seen; but very often lamp-light is better, for Fraunhofer's lines do not interfere with the observations, the quality of the light is more uniform, and, the lamp being placed at about the same height as the prism, the requisite inclination of the microscope is then just that which is most convenient for the observer. In using a lamp, a large bull's-eye condenser should be placed between it and the slit, so as to give a broad or narrower image, according to circumstances; and by throwing the image of the edge of the flame on the object, a larger amount of blue light may be obtained, if that be requisite. With day-light the condenser is not necessary, but the slit must usually be raised, the microscope inclined at a less angle, and a screen of blackened cardboard, with a suitable opening, placed in front of the slit, extending from the table to some distance above *b*, so as to shut out extraneous light. Since the uniform blackness of the field is often impaired by seeing the reflection of various parts of the microscope from the upper surface of the condenser, it is in all cases desirable to have a blackened tube fixed over the end of the object-glass, extending down nearly to the focus.

When all is properly arranged, the narrow beam of light passing through the slit at *a*, gives a spectrum at the focus of the achromatic condenser (*f*), which is so adjusted that the focus may coincide with any object placed on the stage at *g*. Both are magnified by the object-glass (*h*), and seen on looking down the microscope; the spectrum extending horizontally across the field, having the red at the top and the blue and violet at the bottom. In my description it will therefore often be convenient to speak of the red as the upper, and the blue as the lower, end of the spectrum. The breadth depends on the focal length of the condenser and object-glass, and also on the distance of the slit from the prism, and the thickness and refracting power of any object placed on the stage at *g*. By using suitable lenses, we may readily obtain a spectrum $\frac{1}{1000}$th of an inch in width, so that the whole may be seen through a crystal of that minute size, or we may make the spectrum spread over the whole field of the microscope. However, it is usually much better not to have the condenser and object-glass of short focal length, since there is then more light, the spectrum is of better quality, and the different portions in better focus. A condenser of $\frac{2}{3}$rds of an inch focal length combined with an object-glass of $1\frac{1}{2}$, or a $1\frac{1}{2}$ combined with a $2\frac{1}{2}$ answer very well.

By using a micrometer in the eyepiece, the position of any dark or bright band in the spectrum can be readily measured with sufficient accuracy. I find it very convenient to use such powers, and fix the slit at such a distance that the whole spectrum measures twelve divisions of a micrometer, having lines $\frac{1}{200}$th of an inch apart. In that case the sodium line is as nearly as need be three from the top and nine from the bottom. The slit can be easily kept at the proper distance by means of a strip of wood resting above the prism and on the slit. To get a correct datum with lamp-light, I have a platinum wire with a loop holding common salt, so arranged that it can be turned into the flame, and the sodium line seen as a bright yellow band in the spectrum. After making one of the chief lines of the micrometer coincide with this, the wire can be turned out of the flame, and the position of any part of the spectrum measured. If day-light be employed, and a good object-glass used for the condenser, Fraunhofer's principal lines can be readily seen, and D may be made use of as a datum in a similar manner.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

ACADEMY OF SCIENCES.

April 10, 1865.

MM. Michaelson and Lippman presented a memoir "*On Bromide of Benzylidene and Two Hydrocarbons Derived from it.*" Benzylidene C_7H_6 the authors consider the hydrocarbon common to all benzoylic compounds, and of which bitter almond oil is the oxide. The chlorobenzol of M. Cahours—$C_7H_6Cl_2$—they regard as chloride of benzylidene. They sought, therefore, to isolate the hydrocarbon, and with this view first set about preparing the bromide $C_7H_6Br_2$. For this purpose they took bitter almond oil (free from prussic acid) and treated it with perbromide of phosphorus, added slowly to avoid a complete decomposition. The compound obtained was washed with dilute potash to remove oxybromide of phosphorus, bromide of benzoyl, and benzoic acid, and subsequently with a strong solution of bisulphite of soda, to remove the unacted-on oil of bitter almonds. The residue, after drying over chloride of calcium, was distilled in a vacuum, the first and last portions of the distillate being rejected. Analysis showed that the middle product was the desired compound—$C_7H_6Br_2$. It is a refractive liquid, which becomes coloured red in the light, soluble in alcohol and ether, and which, under a pressure of 20 mm., distils between 130° and 140°. Sodium acts violently on this liquid at 180°, much hydrobromic acid being disengaged. The solid mass left, exhausted with ether, gives, on the evaporation of the latter, an almost black semi-liquid mass, which on distillation first yields toluol. The black residue remaining, distilled with the vapour of water, yields yellow oily drops, which solidify to a crystalline mass, which, after purification by successive crystallisations from ether, proves to be a hydrocarbon $C_{14}H_{14}$, which the authors think may be identical with the benzyl

$$\left.\begin{matrix} C_7H_7 \\ C_7H_7 \end{matrix}\right\}$$

obtained by Cannizzaro and Rossi. It is, they say, a diatomic hydrocarbon, for it combines directly with two atoms of bromine.

M. Wurtz contributed a note "*On Abnormal Vapour Densities.*" The author has already published an account of his experiments with hydriodate of amylene; he has now extended his researches to the hydrobromate. This body he shows to offer a normal vapour density up to 40, 50, and 60 degrees above its boiling point; but after this the density begins to diminish until it is reduced to half. The hydrobromate is thus shown to be decomposed into its constituents, which re-combine as the vapour cools. But not entirely, for a trace of hydrobromic acid remains uncombined, and is detected on opening the flasks under mercury. The hydrobromate of amylene, the author states, is specially convenient for determinations of this kind, since it resists a temperature of 360° without blackening. He gives a table, showing the vapour densities at various temperatures from 153°, at which the density equals 5·37 to 360 degrees, at which the density falls to 2·61. The decrease of density is not accomplished with perfect regularity. It falls slowly between 153° and 185°, but very rapidly from 193° to 248°. Above 250° the diminution is again slow. M. Wurtz concludes that at 150° the vapour is intact, for it has the normal density. At 314° the density equals 2·98, and the vapour is then composed as under:—

Undecomposed hydrobromate . . .	13·8
Amylene and hydrobromic acid gas . .	86·2
	100·0

These facts the author considers to support the views of Deville on the dissociation of compounds at temperatures below that of total decomposition. He has extended his experiments to an examination of the vapour densities of hydrobromate of caprylene, which he finds to offer a normal density at 277°.

M. Mège Mouriès presented a note "*On the Preparation of Soaps, and Fatty Acids for Candles.*" The author is not too explicit in his communications to the Academy, and all we can gather from his communication is an opinion that his process yields better products and a larger yield than the ordinary processes. He has said as much before in a former communication which we published in vol. ix., p. 291, of the Chemical News.

M. Lamy contributed a note "*On the Phosphates of Thallium.*" We give here the author's results as stated, leaving controversial matters for another occasion. Thallium forms several compounds with phosphoric acid:—

A neutral phosphate,	$PO_5,2HO,HO + HO$
An acid phosphate,	$PO_5TlO,2HO$
A basic phosphate,	$PO_5,3TlO.$
A neutral pyrophosphate,	$PO_5.2TlO$
An acid pyrophosphate,	PO_5,TlO,HO
A metaphosphate,	$PO_5,TlO.$

All these salts are white, nearly all soluble in water, and insoluble in alcohol. They give white precipitates with hydrochloric acid, and with nitric acid also when the solutions are cold and not very dilute. The phosphates and pyrophosphates give besides white precipitates of tribasic phosphate with alkalies, while they are not precipitated by alkaline carbonates nor by alkalies in the presence of carbonates. The neutral phosphate is obtained by saturating phosphoric acid with carbonate of thallium; when heated this salt loses its water, and is converted into a transparent vitreous mass of neutral pyrophosphate. Phosphoric acid added to the former salt gives an acid phosphate, a very soluble salt crystallising in pearly plates. This salt when heated loses one or two equivalents of water, and gives either acid pyrophosphate or metaphosphate. The basic phosphate is made by adding an alkali to a solution of one of the two phosphates. This salt is but slightly soluble in water. From the general behaviour of the phosphates, M. Lamy draws conclusions in favour of the alliance of thallium with the alkaline metals, in support of which opinion he also quotes some other properties of thallium compounds.

M. Lorin communicated "*A Method of Reduction in Neutral Liquids*," in which there is nothing new. A mixture of zinc and iron heated with ammonia and an ammoniacal salt rapidly disengages hydrogen, the reaction becoming tumultuous as the temperature rises. Nitrate of ammonia, however, in dilute solution, submitted to the same treatment yields protoxide of nitrogen.

NOTICES OF BOOKS.

Chemical Technology; or, Chemistry in its Application to the Arts and Manufactures. By THOMAS RICHARDSON, M.A., Ph.D., &c., and HENRY WATTS, B.A., F.C.S. Second Edition. Vol. 1. Part 4. London: Baillière. 1865.

(Continued from page 177.)

THE stannates of soda and potash, the methods of manufacturing which we find next described in the work before us, are of considerable commercial importance; but the processes by which they are produced offer nothing of particular interest. Those of Mr. Young are of the simplest character. He boils tin ore with caustic soda, and so obtains the stannate at once; or he fuses the tin ore with nitrate of soda, and thus procures stannate of soda and nitrous and nitric acids as by-products. The nitrate of soda may be replaced by chloride of sodium, and hydrochloric acid obtained for the by-product. On fusing metallic tin with solid hydrated soda, water is decomposed, and a stannite of soda is produced. On boiling this in water metallic tin is deposited, and stannate of soda is formed; or a little oxide of manganese added to the mixture of tin and soda before fusing converts the whole into stannate at once. Tin ore heated with alkaline sulphides also yields stannates; but secondary treatment is required to separate sulphur. This is done by boiling the soluble compound obtained in the fusion with hydrated oxide of manganese and iron. Stannate of soda or potash is also obtained by decomposing a stannate of baryta with an alkaline sulphate.

Dr. Richardson employs the alloy of tin and lead obtained in refining hard leads for the manufacture of stannates. He exposes the alloy to a current of hot air until it is completely oxidised. He then dissolves out the oxide of lead with acetic or nitric acid, and the residual binoxide of tin is converted into an alkaline stannate by one of the previously-mentioned processes.

In the short account of the processes for the valuation of tin ores in the dry, the reduction by means of cyanide of potassium is not mentioned. This process, which we published in our last volume (p. 315), is one of the most easily executed of dry analyses, and sufficiently accurate for all commercial processes.

Passing to the Tungstates, we find a full description of Mr. Oxland's process for the manufacture of neutral tungstate of soda, illustrated by useful drawings of furnaces. The process consists in heating wolfram ores with soda ash, in proper proportions, which gives tungstate of soda at once, mixed with the other matters in the ore. These are separated by lixivation, to effect which Mr. Oxland has an ingenious arrangement of vats. The other methods of producing tungstates require no notice; nor does Mr. Emerson's fancied discovery of a new metal *chlorolithenium*. The uses of the tungstates in dyeing and rendering fabrics non-inflammable are briefly mentioned and described.

The valuation of tungsten ores is a simple matter. If they do not contain tin they may be dissolved in *aqua regia*, the solution evaporated to dryness, and the soluble chlorides removed by solution in acidulated water. The tungstic acid which remains is washed with alcohol, and then dissolved in ammonia, which separates it from any silicic or niobic acid. If tin was present in the ore, the residuum after dissolving out the chlorides will be a mixture of tungstic acid and binoxide of tin, which may be treated by Mr. Dexter's process, who ignites it in a porcelain crucible with a perforated lid, through the opening in which he passes a stream of hydrogen. Metallic tin and binoxide of tungsten are thus produced; hydrochloric acid dissolves the former and leaves the oxide of tungsten.

The Chromates come next. Alkaline chromates are of course the starting points for the preparation of all the chromium compounds used in the arts, and the manufacture of these requires the first notice. The process for the manufacture of these is substantially the same as those for the alkaline stannates and tungstates. Chrome iron ore is heated with either an alkaline nitrate or hydrate with free access of air, whereby the sesquioxide of chromium is converted into chromic acid, which combines with alkali, and the soluble chromate is separated from the sesquioxide of iron by lixivation. The alkaline hydrate may be replaced by a carbonate, and if some lime be used an alkaline sulphate may be employed in place of a nitrate. Mr. Tilghmann has patented a process in which he employs felspar as the source of the alkali. He heats a mixture of four parts of felspar and four parts of lime with one part of chrome ore with free access of air. Mr. F. O. Ward has recently patented a similar process with the addition of fluorspar to facilitate the decomposition of the felspar. We need only notice one more process, that of Mr. Booth, who first reduces the iron by means of carbon, dissolves that iron out by sulphuric acid, and so produces green vitriol, and subsequently converts the residual sesquioxide of chromium into a chromate in the usual way. In this process it is said the whole of the chromic oxide is converted into chromic acid.

We see no allusion here to Kuhlmann's suggestion of the use of baryta as a base of chromic acid in place of potash. Chromate of baryta is said to effectively replace the alkaline chromate in many of its applications, and of course is most convenient in the preparation of chromic acid, as here described in the process of Mr. C. Watt.

The value of a chrome ore depending on the amount of chromium, the valuation is easily effected by a process similar to those for obtaining chromates; but it is best to employ a mixture of soda lime with a little nitrate of soda. Mr. Crace Calvert's process, here fully described, may be recommended for the ease with which it may be executed, and the satisfactory results obtained.

The preparation of alkaline silicates, and their application to the manufacture of artificial stone and the preservation of buildings, have been so frequently alluded to in our pages as to call for no notice from us beyond the remark that the account of them in this book, although it might have been fuller, is perhaps sufficiently full. But the authors might without much trouble have found some useful applications of silicates besides those of Fuchs, Kuhlman, and Ransome, who usually monopolise the attention of book writers.

The best section on the subject of silicates is that on Stereochromy, which any reader interested in the subject will find full of useful information.

(To be continued.)

Annalen der Chemie und Pharmacie. March, 1865.

Among the papers in this number with which we have not met before is one by Limpricht, "*On Some Ingredients of Flesh-juice,*" which will possess much interest for physiological chemists. The flesh of a young horse (the author does not say how young) was found to contain a considerable amount of dextrin, which the author was unable to detect in ox heart or fish flesh. From the same extract, prepared from about 200 pounds of the horse flesh, he also separated *taurin* and *inosite*. From herrings he obtained inosinic acid. Another original communication is by Dr. Märcker, "*On the Action of Nitrous Acid on Kreatinin.*" A paper by Lossen, "*On Cocain,*" gives a method of separating this, the active principle of coca leaves. The author exhausts the leaves with water acidulated with sulphuric acid. The extract is precipitated with sugar of lead solution, and the excess of lead removed by a saturated solution of sulphate of soda. The filtrate from the precipitate is made slightly alkaline with carbonate of soda, and then shaken up with several times its bulk of ether. Besides the cocain, ether takes up some colouring matter from which the alkaloid is separated by dialysis. With this view the residue from the etherial solution is mixed with water, and then acidulated with hydrochloric acid and placed on the dialyser. The hydrochlorate of cocain passes rapidly into the diffusate, leaving the greater part of the colouring matter behind. To obtain the alkaloid quite pure it may be again precipitated by carbonate of soda, and recrystallised several times. The author, who took up this research after the death of Niemann, gives as the formula of Cocain $\text{Ꞓ}_{17}H_{21}N\Theta_4$, which differs by one of carbon and one of hydrogen from the formula of Niemann. The alkaloid crystallises in colourless six-sided prisms; one part will dissolve in 704 parts of cold water; alcohol and ether dissolve it freely. A dilute solution of the hydrochlorate shows the following reactions:—Alkalies, caustic and carbonated, give a white precipitate; stannous chloride a white precipitate soluble in much nitric acid; mercuric chloride a bulky precipitate soluble in alcohol, sal ammoniac, and hydrochloric acid; chloride of gold a yellow precipitate in very dilute solutions; chloride of platinum a yellowish-white precipitate, which soon becomes crystalline; picric acid a yellow precipitate, which in a short time agglutinates; phospho-molybdic acid a yellowish-white flocculent precipitate. Tannic acid alone gives no precipitate, nor does iodide of potassium, bitartrate of potash, acetate of lead, ferric chloride, iodic acid. The author then describes some salts of cocain. When cocain is heated with strong hydrochloric acid in a sealed tube, it splits up into benzoic acid, methylic alcohol, and a new base, *Ecgonin* $\text{Ꞓ}_9H_{15}N\Theta_3$, the chemical properties of which closely resemble those of cocain. The article concludes with some observations which establish a close resemblance between cocain and atropine.

The last paper we need notice is by Städeler, "*On Crystallised Carbonate of Potash.*" In the preparation of uroxanic acid by the action of potash solution on uric acid. Besides the above-named acid and oxalate of potash, the author obtained from the mother liquors large transparent, colourless prisms of a salt, which, on analysis, proved to be $2KOC_2O_4 + 3aq$. Städeler examined crystals of carbonate of potash prepared in other ways, and concludes that a salt with four atoms of water does not exist.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

580. T. Horton, Priors Lee Hall, Shropshire, and D. S. Price, Great George Street, Westminster, "Improvements in the treatment of certain products obtained in the smelting of iron."—Petition recorded March 2, 1865.

618. E. Pettit, Birmingham, "A method of, or process for producing a new kind of photographic pictures."—November 4, 1864.

677. T. Reissig, Manchester, "Improvements in ascertaining the presence of 'fixing' agents in photographic productions, and in removing the said fixing agents therefrom."—A communication from W. Reissig, Vienna."—March 10, 1865.

691. J. Henderson, New York, "Improvements in the process and apparatus for refrigerating or freezing liquids."—March 11, 1865.

703. J. Webb, Lawrence Pountney Lane, London, "Improvements in the application and utilisation of certain materials suitable for the manufacture of paper."—A communication from J. J. Monteiro, Lisbon.—March 13, 1865.

727. W. E. Newton, Chancery Lane, "Improvements in apparatus for distilling oils and other liquids from coal and other substances."—A communication from W. G. W. Jaeger, Baltimore, U. S. A., March 15, 1865.

762. T. Kenyon, Miles Platting, Manchester, "Improvements in preparing, fixing, and mordanting cloth and yarns."—March 18, 1865.

788. R. A. Brooman, Fleet Street, "Improvements in the preparation of hydrated oxide of chromium." A communication from C. Kestner, Thann, France.—March 21, 1865.

796. W. M. Williams, Wrexham, Denbighshire, "Improvements in apparatus for the distillation of coal and peat, and such other substances as are or may be used for the manufacture of solid and liquid hydrocarbons, or for the manufacture of the said hydrocarbons and coke."

799. W. J. Coleman, Bury St. Edmunds, "An improved composition for clarifying and fining beer and other fermented liquors."

806. M. Morgans, Brendon Hills, Somersetshire, "Improvements in the manufacture and refining of iron and steel."—March 22, 1865.

817. R. A. Brooman, Fleet Street, "Improvements in treating fats and fatty matters for the manufacture of candles." A coumunication from E. Daugivillé and V. Baliat, St. Berain-sur-D'heuve, France.—March 23, 1865.

871. J. C. C. Halkett, Cramond House, Mid Lothian, N.B., "An improvement in paints or compositions used for coating iron or wooden vessels and other structures exposed to the action of sea water."

877. R. Young, Dublin, and C. F. O. Glassford, F.C.S., Galway, "Improvements in the preparation or treatment of sea-weed, and in obtaining products therefrom."—March 28, 1865.

891. J. Player, Norton, Durham, "Improvements in furnaces or apparatus for heating the blast for furnaces used in smelting iron, and for other furnaces."

893. W. M. Fuller, "An improved process for reducing or preparing waste animal matters for the purpose of employing the same in the preparation of manures or fertilising compounds."—March 29, 1865.

797. H. Potter, Manchester, "Improvements in treating waste liquors obtained in bleaching certain vegetable substances."—March 22, 1865.

814. C. H. Crowe, Gloucester Road, Regent's Park, "Improvements in stoppers for bottles, jars, and other

vessels, the same being applicable to firearms and ordnance."—March 23, 1865.

834. J. B. Brown, St. Petersburgh Place, Bayswater, "Improvements in casks or vessels for storing petroleum and hydrocarbons."

836. W. E. Newton, Chancery Lane, "Improvements in the manufacture of ink."—A communication from J. V. Lavers, Sydney, N.S.W.—March 24, 1865.

874. A. D. Gascon, Rue de la Fidélité, Paris, "A new febrifuge and digestive elixir."—A communication from A. Gascon, Ternes, Paris.

880. E. Savage, West Meriden, Conn., U.S.A., "Improvements in hardening and tempering steel."—March 28, 1865.

Notices to Proceed.

2981. R. F. Dale, Shoe Lane, London, "A new apparatus to be employed in drawing off and measuring paraffin and other oils, applicable also in drawing beer and other liquids, and measuring the same."—Petition recorded Nov. 30, 1864.

3048. C. A. Martius, Warrington, Lancashire, "Improvements in the application of photography to the ceramic art or to glass." A communication from J. B. Obernetter, Munich.—Dec. 6, 1864.

127. J. Young, Limefield, county of Mid Lothian, N.B., "Improvements in producing gases and vapour in a heated state."—Jan. 14, 1865.

222. J. H. Pepper, Boundary Road, St. John's Wood, and T. W. Tobin, North Street, Pentonville, "A new or improved apparatus for illusory exhibitions."—Jan. 26, 1865.

734. S. B. Boulton, Charlotte Row, Mansion House, London, "Improvements in the means and apparatus employed for treating timber with antiseptic or preservative fluids, also applicable to other purposes."—March 16, 1865.

CORRESPONDENCE.

Continental Science.

Paris, April 17.

Scientific news is scarce here, and your Parisian contemporaries are reduced to the publication of extracts from the catalogues of apparatus and instrument makers. As these are well illustrated with diagrams and cuts, the extended publication of them will be useful, and I may refer you to the last number of *Les Mondes* for an account of some highly interesting acoustic instruments made by M. Koenig. The illustrated catalogue of this gentleman is, it is said, and without exaggeration, a real treasure to professors of physics, and deserves to be as well known in England as here. Unfortunately a verbal description of those instruments without the drawings would not have the smallest value, and I leave them with regret to notice matters of less scientific but more practical interest. One of these is a "dynamic evaporator," invented by M. Toselli, who is a manufacturer of ice-making machines. In these machines he employs a mixture of carbonate of soda and nitrate of ammonia to produce cold, and consequently gets a large quantity of solution of these salts on hand, which his object is to evaporate at the least cost. His apparatus to accomplish this is very simple. Parallel cords of vulcanised india-rubber are stretched over two rotating cylinders turning on horizontal axes. The lower cylinder revolves in a trough containing the saline solution, which is carried up by the cords, and the water is quickly dissipated, especially when the operation is carried on in the open air, and the solution brought down to a crystallising point.

There is another useful invention that deserves to be known in London, and this is the kneading trough, devised by M. Lenoir, the inventor of the gas engine. It is of course adapted to the gas engine, which any journeyman baker could manage after half an hour's instruction. The mechanism imitates exactly the work performed by the baker's arms, and it is needless to say performs it without the disagreeable accompaniments of the human machine. The wooden kneaders do not perspire, nor is it necessary to hang a perspiring head over the trough. As a promoter of cleanliness and saver of labour, this machine deserves to be well known.

I believe I have mentioned before the discovery of a new silkworm in South America. We have to-day a further account of it from the brothers Durant Savoya, of Parana, who have found the same worm in provinces of Santa Fé and Entre Rios, in the Argentine Republic. The worm, which they propose to call Bombyx Platensis, feeds on a mimosa identical with that which yields gum arabic and senegal. In dry seasons, the writers say, large quantities of these gums may be collected. The siliques are exceedingly rich in tannin, and may prove of value. The tree and the worm also, they believe, could be easily introduced and acclimatised in the South of France and Algeria. The importance of the silk industry to this country is so great that people look with intense interest on any new source of the material.

An incident at the last meeting of the Academy recalls to mind the archeological discovery of the immortal Pickwick. There was mention made some time ago of a great find of flint implements at Pressigny-le-Grand, in the vast antiquity of which MM. Quatrefages and Mortillet expressed their firm belief. M. Decaisne, however, went to the spot and questioned people living near, who told him that in past times tramps came every year and made gun-flints on the spot, and departed, leaving, of course, their chippings behind, veritable relics of an almost forgotten age—the age of flint locks.

If you have any entomologists among your readers, they may be glad to hear of a highly successful method of preserving the objects of their interest. M. Gerber employs an etherial solution of carbolic acid with ten per cent. of the latter, which he finds to effectually protect the insects even in a place infested with ants. He recommends the solution especially therefore to entomologists making collections in hot countries.

I have sometimes felt surprise that no enterprising man in England had ever taken out a patent for the use of air for breathing purposes. What an extensive field that would open for royalties! I do not think that people here are quite so ready in attempting to monopolise common property as some in England, but one inventor(?) of the kind has just been put down at Toulon. This is M. Diess, who had the assurance to patent the use of sulphide of carbon for extracting grease, and the impudence to bring an action against a M. Deprat for infringing his patent. It is needless to say that the patent was considered "invalid for want of novelty!"

Formulæ for New Copper Minerals.

To the Editor of the Chemical News.

Sir,—Will you permit me to answer in your journal some questions which have been lately asked me? Several correspondents seem desirous to know what formula I assign to the new cupric oxychlorides of Cornwall, and whether I regard them as distinct mineral species.

As to the first point, the following list will afford, I trust, sufficient information. The *new* minerals are marked *, and are distinguished by their colours :—

1.	Atacamite . . .	$Cu''Cl_2$, $3Cu''H_2O_2$, aq.
2.	*Pale Mountain Green .	$Cu''Cl_2$, $3Cu''H_2O_2$, 3aq.
3.	*Turquoise Blue . .	$Cu''Cl_2$, $4Cu''H_2O_2$, 4aq.
4.	*Deep Blue . . .	$Cu''Cl_2$, $6Cu''H_2O_2$, 6aq.

The account of 1 and 3 will be published shortly in the Journal of the Chemical Society; the history of 2 and 4 will be made the subject of a second memoir.

As to the specific distinctness of these minerals, the data in my possession are as yet scarcely sufficient for a final judgment. I may say, however, that I am inclined to regard some of these oxychlorides as in a transitional condition; not, if I may be allowed the expression, as *mature* minerals. I am, &c. A. H. Church.

R. A. College, Cirencester, April 3.

MISCELLANEOUS.

Royal Institution.—The following are the arrangements for the ensuing week:—Tuesday, April 25, at 4 o'clock, Professor Frankland, F.R.S., "On Organic Chemistry." Thursday, April 27, at 4 o'clock, Professor Frankland, F.R.S., "On Organic Chemistry." Friday, April 28, at 8 o'clock, Professor Lyon Playfair, C.B., F.R.S., "On the Diet of Man in relation to his Useful Work." Saturday, April 29, at 4 o'clock, Professor Bain, "On the Physical Accompaniments of Mind."

Royal Polytechnic Institution.—The Easter entertainment provided by Professor Pepper is of an unusually attractive character. Since the first apparition of the ghost at the Institution, nothing, we believe, will prove so permanently attractive as the new illusion introduced under the title of "Proteus; or we are here, but not here." The mysterious cabinet in which these startling illusions are produced will become more celebrated than the cabinet of the Davenport Brothers; for the tricks performed in it are, to common eyes, much more wonderful and mysterious. The production of Captain Burton's Pilgrimage to Mecca and Medina is highly creditable to the good taste of the manager, and the scenic and optical effects illustrative of incidents in the life of Mahomet deserve the highest praise. We ought also to say a word in favour of the exhibition of models of inventions calculated to promote safety in railway travelling, described by Mr. King. On looking at these models, we seem to see the possibility of avoiding every danger of railway travelling. There is a system of breaks invented by M. Boutet, which brings a heavily-laden train to an almost immediate stand-still, without producing a jar sufficient to disturb a spinning top; and a system of signals, by the same inventor, in which the trains act on the signals as they pass along, which are thus made independent of drowsy or careless signalmen. There is also at the Polytechnic a nice admixture of the amusing with the instructive, and an evening may now be spent there most agreeably and profitably.

Sewage of Towns.—Another instalment of the researches of the Commission appointed to inquire into the best mode of distributing the sewage of towns, and applying it to beneficial and profitable uses, has just been issued. The last report, as long ago as August, 1861, since which date Mr. Lawes and Professor Way, two of the Commissioners, have continued at Rugby the experiments which were undertaken in that year on the application of sewage to land. In reference to these experiments the Commissioners express their conviction that many of the difficulties which have hitherto attached to the question of the agricultural application of sewage have been solved, and leave no reasonable doubt of the practicability and advantage of so employing the sewage of towns. As the result of their labours, extending over eight years, the Commissioners submit the following as the conclusions they have arrived at:—"1. The right way to dispose of town sewage is to apply it continuously to land, and it is only by such application that the pollution of rivers can be avoided. 2. The financial results of a continuous application of sewage to land differ under different local circumstances. First, because in some places irrigation can be effected by gravity, while in other places more or less pumping must be employed. Secondly, because heavy soils (which in given localities may alone be available for the purpose) are less fit than light soils for continuous irrigation by sewage. 3. Where local circumstances are favourable, and undue expenditure is avoided, towns may derive profit, more or less considerable, from applying their sewage in agriculture. Under opposite circumstances there may not be a balance of profit; but even in such cases a rate in aid, required to cover any loss, need not be of large amount. Finally," say the Commissioners, "on the basis of the above conclusions, we further beg leave to express to your Lordships that, in our judgment, the following two principles are established for legislative application:—First, that wherever rivers are polluted by a discharge of town sewage in them, the towns may reasonably be required to desist from causing that public nuisance. Second, that where town populations are injured or endangered in health by a retention of cesspool matter among them, the towns may reasonably be required to provide a system of sewers for its removal. And should the law as it stands be found insufficient to enable towns to take land for sewage application, it would, in our opinion, be expedient that the Legislature should give them powers for that purpose." Embodied in the Blue Book of the Commissioners is the report of the experiments conducted at Rugby by Mr. Lawes and Professor Way. These experiments were of a very varied and interesting character, and applied among other purposes to meadow land, to Italian rye-grass—experiments with fattening oxen and with milking cows; showing also the composition of the Rugby sewage, estimated average composition of the metropolitan sewage, composition of the drainage water (Rugby), and the effects of sewage on the mixed herbage of meadow land in developing the more freely growing at the expense of the less freely growing plants. Mr. Lawes and Professor Way, in their summary of the results of their inquiry, state that as there is a daily supply of sewage the year round, which, on sanitary and engineering grounds, it is essential to dispose of as soon as it is produced, and as passing it over land is the best mode of purifying and utilising it, it should be employed for purposes of irrigation, and be applied in winter, when of comparatively little value, as well as in summer, when it is of more. They state further that to obtain a maximum amount and gross value of produce from a given amount of sewage, it should be applied in small quantities per acre, and in dry weather; but the great dilution of town sewage, its large daily supply at all seasons, and its greater amount in wet weather, when the land can least bear, or least requires, more water, render it quite inappropriate for application on a comprehensive scale to arable land for corn and other ordinary rotation crops. The five appendices given with the report of the Commissioners embrace much tabular matter illustrative of the results of the experiments referred to; also notes on the sewage meadows of Croydon and Edinburgh; a paper by Mr. R. Rawlinson on the sewage of towns; and one on the contamination of air and water by sewage, by Dr. Stephenson Macadam.

ANSWERS TO CORRESPONDENTS.

Vol. X. of the Chemical News, containing a copious Index, is now ready, price 11s. 0d., by post, 11s. 6d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I and II. are out of print. All the others are kept in stock. Vol. XI. commenced on January 6, 1865, and will be complete in 26 numbers.

R. B. P., U.S.A. Laboratory.—The Report is sent as desired.

J. O.—(1.) The paper "On the Estimation of the Mineral Phosphates" is in No. 239 vol. x. (2.) Either Gesner "On the Distillation of Coal" (Baillière), or Antisell "On the Manufacture of Photogen Oils," same publisher. For coal-tar colours read the Chemical News.

Book Received.—"On Letters Patent for Inventions," by F. Edwards, Jun.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Contributions to the History of the Metals in Cerite and Gadolinite, by M. MARC DELAFONTAINE.*

(Concluded from page 174.)

THE following facts seem to me sufficient to set this question at rest:—

With the blowpipe yttria gives, in the two flames, with borax or salt of phosphorus, a limpid pearl, colourless both when cold and hot.

Terbia and erbia behave in the same way.

If they contain cerium, the pearl is opaline in the oxidising flame, dark yellow when hot, and almost colourless when cold.

Mixed with didymium, then heated in the reducing flame with microcosmic salt, they produce, when hot, an opaline glass, which becomes limpid, but turns to a violet amethyst hue on cooling.†

Yttrico-potassic sulphate is soluble in water saturated with sulphate of potash; sulphates of cerium and didymium are not so; consequently, in a mixture of the three earths, sulphate of potash separates the first from the two others.

A salt of yttria containing the minimum amount of cerium gives, with caustic potash, a white jelly, which turns yellow by exposure to the air, and dissolves, after calcination, in acids not too much diluted, giving a red or yellow liquid, hydrate of erbia, remains white in the air, even for several days, and its solutions are colourless.

Erbic sub-nitrate, prepared by the wet way, is dark yellow, even when air is excluded; didymic sub-nitrate is, and remains grey, when either hot, cold, kept from the air, or exposed to it.

Pure lanthanic oxide and yttria being white, give a mixture which is also white.

After moderate calcination didymiferous yttria has a light chocolate tint, while erbia is yellow.

By fractionally precipitating a nitrate of erbia, containing cerium, in the state of double potassic sulphate, the latter portions will give an earth quite as yellow as the first; but a trial with the blowpipe and the chemical analysis of the simple sulphates, will show very clearly that they are free from cerium, the latter being condensed in the first deposits.

The whole of the researches described in the present memoir seem to me to justify the following conclusions:

Mosander's erbia does exist; its composition, established by the isomorphism of its sulphate with that of didymium, is that of a protoxide, of which the symbol would be ErO; its atomic weight is approximatively equal to 576. $(O = 100)$ or 95 $(O = 16\ H)$. It is distinguished from the bases which accompany it in gadolinite by its physical properties, its chemical reactions, its proportional number, and its behaviour with the blowpipe and fluxes.

Yttria is besides mixed with another earth, white, or nearly so, terbia, extremely difficult to distinguish, but which seems, however, to have a different atomic weight.

M. Bahr last year announced the discovery of a new simple body—wasium—extracted from orthite and gadolinite. In a paper published December, 1863, in the *Bibliothèque Universelle (Archives)*, vol. xviii., I proved by experiments the perfect identity of cerium and wasium—in so far, at least, as M. Bahr has described the latter, and he has not since brought forward any fact calculated to weaken this conclusion.

A memoir appeared recently in Germany entitled "Researches on Yttria," by M. O. Popp.‡ The author is thus occupied with the same subject as myself, and he believes he has proved the identity of erbia with oxides of cerium. It appears, moreover, from a passage in his work that M. Berlin regards terbia as a mixture of erbine (the existence of which he admits) and yttria. M. Popp says yttria is a very pale yellow earth, that its atomic weight is equal to 525, and that its nitrate has the property of giving in the spectroscope absorption lines similar to those assigned by Dr. Gladstone didymium.

All the properties of erbia, such as I have given them above, are opposed to the idea of its being a simple mixture of bodies already known. The methods employed to extract it may very likely be insufficient to free it entirely from yttria, but in the state in which I obtained it it was sufficiently pure to make it impossible to attribute its characteristics to any of its congeners.

With respect to terbia I am as yet undecided on the question of its existence, though certain facts would lead me to agree with Mosander in regarding it as distinct. I hope soon to be more decided upon this point.

In fact, yttria is of a very pale yellow colour, but purified as much as possible it has, according to my researches, an atomic weight much less than that assigned to it by M. Popp; the figure found by me is not positive, not being established by a sufficient number of experiments; but, as it very nearly approaches that formerly found by Berzelius, it may be regarded as very nearly exact.

I examined with the spectroscope the absorption band mentioned above. With the apparatus at my disposal I was not able to determine the position of the black lines by means of a given scale; my observations were, however, as follows:—

A concentrated solution of nitrate of didymium, containing lanthanum, interposed between the slit of the apparatus and a continuous spectrum flame, shows two beautiful black lines, large, very clearly defined, situated one nearly at the end of the yellow and orange, near the line D, beside C; the other in the bluest part near G. The space between these two lines is shared equally by two groups of two lines, each equally clear, but straighter than the preceding. The first of these groups is in the centre of the green portion, between E and *b*, the second in the blue, between F and G; it is often accompanied by a seventh line.

Under the same conditions nitrate of erbia manifests slightly different phenomena, the two intermediate groups are replaced each by a simple line; otherwise all the positions and the relative brightness are almost the same. With nitrate of yttria only two fine lines are with difficulty observable; all the others disappear; but, strange to say, the brightest do not remain, and one of them, the largest blue one, disappears.§

A mixture of one-third of didymium and two-thirds of yttria behaves like pure didymium.‖

(All the solutions employed were highly concentrated, and contained in round equal tubes of a centimetre in diameter.)

M. Popp has observed five lines with yttria, three of which coincide with those of erbia in the violet, blue, and green; but the position of the fourth is rather

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* *Archives des Sciences Physique et Naturelles*, Geneva.

† These reactions have been studied chiefly by M. Plantamour.

‡ *Annalen der Chemie und Pharmacie*, cxxxi., 179. This memoir contains studies of many new or little-known salts of yttria. We shall give an abstract of this paper in our next number.

§ This, perhaps, accounts for the dimness of this part of the spectrum.

‖ This experiment plainly shows that erbia is not a mixture of yttria and didymium.

different. I have not seen the fifth, situated in the outer part of the red.

M. Bahr, of Upsala, discovered the absorption lines of erbia, but I have not seen his memoir.[¶]

Since writing the above, I have found that the position and relative brightness of the dull lines described by Popp are perfectly exact, but do not belong to yttria, but to erbia, to which they are peculiar. Yttria (or perhaps only terbia) gives two lines—one in the yellow, the other in the green,—which coincide exactly with those of didyminm, except that they are much smaller.

Hydrofluoric Acid for the Detection and Estimation of Silica, by M. Fred. Kuhlmann[*].

The author proposes to treat silicates at a dull red heat with a current of hydrofluoric acid, and has had made a platinum apparatus adapted for this process. It consists of a platinum retort, of which the belly may be of lead; the acid is produced by means of sulphuric acid and white cryolite, or pure fluoride of calcium. The neck of the retort fits tightly into a tube of platinum which contains, in boats of the same metal, the matter to be analysed; this tube, by means of a short adapter, also of platinum, communicates with a condensing or absorbing apparatus; this apparatus may be of vulcanised india-rubber. One hour suffices for the treatment of 10 grammes of matter, but not more than 2 grammes should be employed. By means of this experiment M. Kuhlmann has ascertained the following facts:—

Amethyst contains no metallic oxide, but soda and potash, which are observed by means of the spectroscope; emeralds and yellow quartz are decolorised; smoky and yellow diamonds, and rubies do not alter in colour; blue sapphire takes a slightly violet tinge.

Blue disthène leaves a ferruginous residue with fluoride of potassium and aluminium; tremolite, pyroxene, quartz, and jaspar give a residue of potash and soda.

Finally, red cornelian, which had turned to a dead white under the influence of oxidising and deoxidising gases, and the colour of which seemed consequently due to an organic matter, was found to be ferruginous, which proves that if oxide of iron enters into the colour of cornelian, it is by reason of a peculiar molecular arrangement, which disappears by calcination under the influence of reducers or oxidising gases.

The Estimation of Fluorine in Phosphates of Iron and Manganese,[†] *by* H. Von Kobell.

The method proposed by the author for estimating fluorine in combinations easily attacked by sulphuric acid is as follows:—Cover the platinum capsule in which the decomposition takes place with a funnel, resting with the capsule on a platinum basin, on which it is fastened with wet plaster; ascertain the weight of the funnel and the composition of the glass of which it is made. Heat the whole until most of the sulphuric acid has been expelled; then raise the funnel, wash it carefully, dry and weigh it; the decrease in its weight is owing to a portion of the glass having been attacked; and as its composition was first ascertained, the weight of silica which has been attacked may be calculated from the decrease in weight, and, consequently, the quantity of hydrofluoric acid which has been disengaged. This method has given very satisfactory results with triplite of Limoges, and with zivieselite, and other analogous phosphates of Schlaggenwald. With fluoride of calcium and cryolite too little fluorine is found, because the decomposition of these minerals is complete only when the mixture is properly shaken, which is difficult with the apparatus described above. The same funnel may be used many times, and is even better after it has been corroded; the author has made it in the form of a receiver, that it may better cover the capsule.

If the substance to be analysed contains silica, the quantity must be ascertained and added to that of the glass attacked, to obtain the weight of fluorine.

The author has experimented by another method. Place the substance to be analysed in a rather deep platinum crucible, and cover it with three or four times its weight of silica; add a few drops of sulphuric acid, and heat gently for half-an-hour; then gradually increase the heat until most of the sulphuric acid is expelled. Then treat the whole with hydrochloric acid, add some water, and leave it to deposit; collect the deposit, calcine, and weigh it, and the loss of silica will indicate the amount of fluorine contained in the substance analysed (38 of fluor corresponds to 30 of silica).

The author analysed the Limoges triplite by both these methods, and found in them from 6·8 to 7·5 per cent of fluor. The heterosite of Limoges contains only 0·902 per cent.

The qualitative research of fluorine in substances free from silica is easily made, with small quantities of matter, in a platinum crucible furnished with a lid, with a small circular hole pierced in the centre, above which a disc of glass is placed.

PHYSICAL SCIENCE.

On the Application of Spectrum Analysis to Microscopical Investigations, and especially to the Detection of Blood stains,[‡] *by* H. C. Sorby, *F.R.S., &c.*

(Continued from page 188.)

I trust I have now made the general arrangements sufficiently intelligible, and will proceed to describe some of the objects to which the instrument may be applied.

Detection of Blood-Stains.—Passing from these almost purely scientific questions, I will now describe the application of the spectrum microscope to a very practical subject, viz., the detection of blood stains in criminal inquiries. The optical properties of blood have been described by Hoppe,[§] and in still greater detail by Professor Stokes.[‖] Hoppe suggested that the peculiar and characteristic spectrum of fresh blood might be employed as a test, but the plan he proposed was to moisten the blood-stain with water and examine it direct, which of course could not be done if it were on a highly-coloured fabric. Professor Stokes also suggested that the spectrum of deoxidised hæmatin might be employed for the purpose, but did not further develop the subject, being evidently desirous to investigate it chiefly in relation to chemistry, optics, and physiology. However, in considering the question, I soon became convinced that it deserved a most careful study, with special reference to the detection of minute traces of blood in criminal investigations, and therefore have directed a great amount of attention to that point alone. Such inquiries almost necessarily fall into the hands of a microscopist; and,

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[¶] See *Ann. der Chemie und Pharmacie*, cxxxi., 256.

[*] *Comptes Rendus*, lviii. 548.

[†] *Journal für Praktische Chemie*, xcii., 385, 64.

[‡] From the *Quarterly Journal of Science.*

[§] Virchow's *Archir.*, vol xxiii. (1862), 446.

[‖] *Proceedings of R. S.*, xiii. (1864), 355.

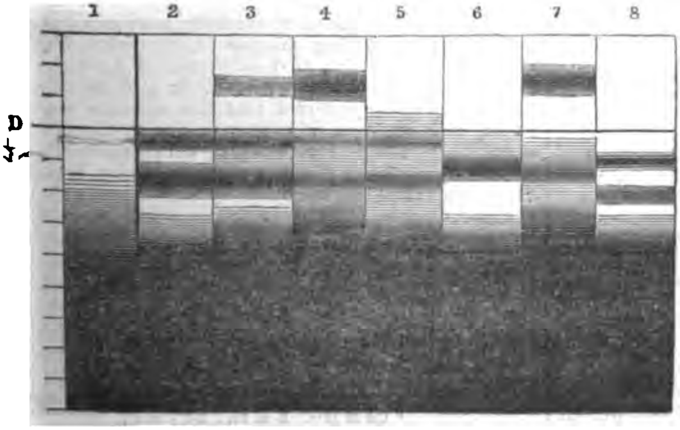
as I shall show, the apparatus I have described will enable any one to detect with certainty most marvellously minute traces of blood when the usual methods would entirely fail. That merely chemical tests are generally suspicious, and often not to be trusted at all, is freely admitted by my friend Dr. Allan, who has had much experience in such inquiries; and, of course, if the red globules have been destroyed, the microscope alone is of little or no use. In such cases the method I now propose comes to our aid, and enables us to detect as small a quantity as $\frac{1}{1000}$th of a grain of the colouring matter of blood left on a fabric from which apparently all traces have been washed, or which only shows a slight discoloration. If all has been washed out, its detection is no longer possible, for it is this colouring matter itself, and not any action on the material, that proves the former presence of blood.

Since in studying the spectra of blood it is important to be able to operate on small quantities, I have employed cells, cut from a barometer tube, having an external diameter of about half an inch, an internal diameter of one-eighth, and half an inch long, slightly polished at both ends. These may be fixed with Canada balsam in the centre of pieces of glass about 1·6 square, or, what is still better, in the centre of the longer side of triangular pieces, formed by cutting such squares along a diagonal, so that two may be placed side by side in front of the slit, and the spectra of two solutions compared together at one view. Liquids can be readily introduced into such cells by means of a moderately stout platinum wire; and when rather more than full, so that a little spreads over the top of the cell, a piece of thin glass can be easily put on without inclosing any bubble, and the surplus removed with blotting-paper. Capillary attraction keeps the glass on, and evaporation takes place so slowly that everything remains for a considerable time in a proper condition; and if desirable, the glass may be fixed on by means of gold size, and the solution kept for weeks. Placing such a cell in front of the slit, as at *a* in Fig. 1, the light passes through the thin glass at the top, through the column of liquid and the thick glass at the bottom, and then through the narrow slit to the prism. Cells of less diameter than one-eighth of an inch might be used, but it is difficult to fill and empty them. Even when one-eighth in diameter, if it be requisite to transfer the solution to a watch-glass it is well to have a piece of such tube as is used for spirit thermometers, drawn out at one end and bent at a right angle, so that it may be introduced to the top of the cell, and the liquid removed by blowing down the tube.

The exact position of the dark absorption bands in the spectra obtained from blood being a very important character, it is necessary to make use of the micrometer; and I have found that for this purpose it is well to arrange the instrument so that the width of the entire spectrum is about 12, as shown by the divisions on the left-hand side of Fig. 2. I shall adopt this method of measurement in all my descriptions. Gas-lamp light is, if anything, better than daylight, because the line C of Fraunhofer interferes with the correct determination of some facts. Turning a wire holding common salt into the flame, the bright yellow sodium line is seen; and one of the principal lines of the micrometer having been made to bisect it, the wire is turned out of the flame and the measurements made.

Since human life might depend on the accurate determination of the facts, I shall describe all the characteristic peculiarities of the spectra, so as to avoid, as far as possible, any serious mistake. If a piece of linen, one-eighth or one-tenth of an inch square, soaked with blood, and quite recently dried in pure air, be digested in a few drops of water in a watch-glass, it yields a solution, which, when introduced into one of the cells just described, produces a spectrum like No. 2 in Fig. 2. The blue end is quite absorbed, and so are two bands in the green, but the whole of the red end is transmitted. When the solution is stronger the absorbed portion of the spectrum increases upwards, and the dark bands in the green become broader, until the whole of the light below D is absorbed, and merely a bright red remains above it. If examined when the yellow sodium line is present a narrow dark band is seen just above it, even when the spectrum is like No. 2, and shows no such dark band in that position with the natural light. On diluting the solution the bands in the green become more and more narrow and faint, but do not disappear until it is so dilute that the blue end of the spectrum is transmitted without sensible alteration. Since the width of the bands varies with the strength of the solution, the position of their edges is not constant, though that of their centre is nearly so, and will be given in the following descriptions. However, it is somewhat difficult to determine it with great accuracy on account of the gradual shading off on each side, which, of course, can be only imperfectly represented by a woodcut. Taking the whole spectrum at 12, the centre of the upper band is at $\frac{1}{3}$ or ·4; of the lower, $1\frac{2}{3}$; and of the green between them, 1. The upper band has a sharper outline, and, when so much blood is present as to cut off about $\frac{1}{2}$ of the spectrum, its width is about $\frac{2}{5}$ that of the lower, as shown by No. 2. As a good example of an entirely different spectrum, given by a solution of very similar colour, I refer to No. 1, which represents that of a dilute solution of perchloride of iron to which a little sulphocyanide of potassium has been added. In its case the blue end of the spectrum is more and more absorbed, according to the strength of the solution, but no narrow dark bands are formed in any part. The spectra of many red colouring matters have this character, and therefore could not possibly be confounded with blood. Cochineal does, indeed, yield an absorption band in the same position as the lower in fresh blood, but it is ex-

FIG. 2.—BLOOD SPECTRA.



tremely faint, and there is none where the upper band occurs. A second does exist, but it is 3¼ below D, and is seen only when the solution is so dilute that the blue part of the spectrum is freely transmitted. On adding ammonia to the solution of cochineal, two absorption bands are produced in such a position that without care they might be confounded with those of blood; but the upper is decidedly broader than the lower, whilst it is the reverse in blood; and its centre is also lower, being ½ and not ⅓ from D. A solution of cudbear in dilute alcohol also yields two very faint bands in much the same place as those in fresh blood, but on adding ammonia the band at ½ becomes very dark and distinct, and the lower band vanishes. The addition of ammonia to a solution of fresh blood produces no such changes.

The gravy of roasted meat gives different spectra according to circumstances. The red liquid which comes from it when undercooked is merely a solution of cruorine, and gives the same spectrum as fresh blood; but the usual light or darker brown liquid sometimes gives a dark and sharply-defined absorption band at about 1·4 below D, and suddenly cuts off all the rays below 2¼. The addition of ammonia causes a precipitate, but leaves an obscure band in the same situation. Citric acid removes the band entirely, but ammonia in excess restores it without causing a precipitate, and the addition of protosulphate of iron produces no change. When dried and strongly heated the colour becomes darker, and it merely cuts off more or less of the blue end of the spectrum, as in No. 1, without there being any detached absorption bands. Probably this is why dark-coloured gravy often has that character. Thus, though, as far as tests are concerned, the chemical composition is almost identical with that of blood, the optical characters and the manner in which gravy behaves with reagents suffice to distinguish it, unless it be from meat so extremely underdone that it is, in fact, merely more or less modified blood.

(To be continued.) b 287?

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, April 20.

Professor W. A. Miller, *M.D., F.R.S., President, in the Chair.*

The minutes of the previous meeting were read and confirmed, and the contributions to the Society's library were announced and acknowledged. The following gentlemen were formally admitted Fellows of the Society, viz.:—Capel H. Berger, R. H. M. Bosanquet, Alexander W. Gillman, W. White Rouch, and John F. Walker, Esqs. The names of the following candidates were proposed for the first time, viz.:—Thomas Fairley, Medical School, Leeds; Edward Swann, Director of the Laboratory of the London and North-Western Railway Company, Crewe; Alfred Upward, Superintendent of the Chartered Gas Company's Works, 148, Goswell-street, London. For the second time were read the names of Dr. Holzmann, Marlborough House; Mr. Thomas C. Kirkham, Gilston Road, West Brompton; and Mr. Joseph Sugden, Jun., Trinity House, Halifax. The names of Mr. Arthur Clegg Bowdler, Oxford Road, Manchester, and Mr. W. E. Heathfield, F.R.G.S., Princes Square, Finsbury, were read for the third time, and, the ballot having been taken, these gentlemen were declared to have been duly elected Fellows of the Society.

Professor Charles L. Bloxam read a paper "*On the Action of Hydrosulphate of Ammonia upon Freshly-precipitated Sulphide of Copper.*" Referring to the well-known fact of sulphide of copper being appreciably soluble in yellow or colourless hydrosulphate of ammonia, the author had undertaken experiments for the purpose of demonstrating the nature of the soluble compound thus formed. The results led to the discovery of a peculiar double sulphide of copper and ammonium which does not appear to have been previously described. For its preparation some recently precipitated and well washed sulphide of copper (obtained by passing sulphuretted hydrogen through aqueous sulphate of copper) was boiled for a short time with colourless monosulphide of ammonium, or with the yellow product obtained by saturating the last-named compound with sulphur. In both cases copper was taken into solution, but the latter condition was that which favoured the production of the desired compound, and when a solution of this kind was set aside for a few hours in a well-closed bottle it deposited splendid crystals of a vermilion-red colour, which assumed the form of tufts of needles, and were very similar to chromic acid. These crystals underwent partial decomposition even when washed with cold water, and by boiling furnished a dark green precipitate of sulphide of copper. Upon adding hydrochloric acid to the yellow solution of the double sulphide an orange coloured precipitate was obtained so nearly resembling the ordinary appearance of sulphide of antimony that the author conceived it might often be mistaken for this substance, and hence the necessity of confirming the presence of antimony by independent tests. By drying the vermilion-red crystals over oil of vitriol the author succeeded in preparing a sample sufficiently pure for quantitative analysis, but they were immediately decomposed by the heat of the water-oven, evolving an ammoniacal odour and turning black from the separation of sulphide of copper. Hydrochloric acid did not act upon the crystals in the cold, but when heated much sulphuretted hydrogen was disengaged and a black residue left. No separation of sulphur was perceptible. Nitric acid was also without action upon the crystals until heat was applied, when violent oxidation took place and much sulphur was separated. The analysis of the compound was effected by boiling a weighed quantity of the crystals with concentrated nitric acid until the separated sulphur assumed the form of pure yellow globules, which were collected and weighed. The sulphuric acid in solution was then precipitated by chloride of barium and the sulphate of baryta also collected and weighed, in order to furnish an indication of the amount of sulphur which had been dissolved. The excess of baryta having been precipitated by sulphuric acid, the copper was determined in the filtrate by boiling with potash and weighing as oxide of copper. For the estimation of ammonia a separate portion of the crystals was boiled with hydrochloric acid until completely decomposed, removing the small quantity of copper which entered into solution by passing a current of sulphuretted hydrogen; the filtered liquid was then carefully evaporated to dryness, and the resulting chloride of ammonium weighed. From the observation that sulphuretted hydrogen was evolved by the action of hydrochloric acid upon the red crystals the author inferred that the ammonia was associated with an atom of hydrogen, and it was therefore calculated as NH_4. Two samples were examined in this manner by Professor Bloxam, the one having been dried over oil of vitriol and the other by pressure between folds of bibulous paper. The resulting numbers indicated the formula—

$$Cu_2NH_4S_7,^*$$

as will be seen by the following comparison:—

	Theory.	Experiment.	
Copper . .	32·81	32·65	32·11
Sulphur . .	57·88	58·07	59·07
Ammonium .	9·31	9·07	8·82

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* $Cu = 31·7$. $S = 16$. $NH_4 = 18$.

The author explained that the divergence between the numbers demanded by theory and those obtained in different experiments was not greater than would be expected in dealing with a compound of so decomposible a nature. Speculating, then, upon the constitution of the substance under examination, it was stated that the two simplest rational formulæ were respectively—

I. $2CuS_3, NH_4S$.
II. $2CuS, NH_4S_5$.

And, whilst the mode of production seemed to favour the latter expression, the author preferred to adopt the first formula, chiefly because there was no sign of sulphur being separated from the compound by the action of hydrochloric acid; secondly, because of the failure of concentrated nitric acid to split up the red substance in the cold; and, lastly, this view was supported by the action of heat upon the crystals. The author gave his opinion in favour of the use of yellow sulphide of ammonium, instead of the corresponding potassium compound, for the purpose of separating copper from the other metals of the sulphuretted hydrogen group in the prescribed method of qualitative analysis, inasmuch as it would be found easier to identify copper in the presence of the metals forming sulphur acids (*e.g.*, antimony, tin, and arsenic), than in searching for it in a mixture of the basic sulphides (*e.g.*, those of bismuth and lead), when its detection presented greater difficulties, especially to an inexperienced analyst.

Professor Bloxam then proceeded to read an interesting communication entitled "*Notes upon the General Routine of Qualitative Analysis for Metals.*" The first point referred to related to the reduction of binoxide of tin by fusion with cyanide of potassium; the author found that the presence of sulphate of potash as an impurity in the ordinary commercial quality of the cyanide of potassium entailed a loss of tin in the reduction of the metal. This error was traced to the formation of sulphide of potassium, which united with an equivalent proportion of sulphide of tin, and rendered it soluble in water when the fused mass was acted upon by that liquid. According to the amount of sulphate originally present in the flux, the black stannous sulphide SnS, or the yellow stannic sulphide SnS_2, would be formed; but in either case the addition of hydrochloric acid in slight excess to the aqueous solution determined the separation of the whole of the dissolved tin. Upon fusing 10 grains of pure binoxide of tin with 50 grains of the commercial cyanide, the globule of reduced metal weighed 7·1 grains instead of 7·8 grains; and on treating the slag with hot water a considerable quantity of black stannous sulphide was recovered, the solution itself giving but a slight yellow precipitate with hydrochloric acid. On repeating the experiment with the same proportions as before, but with the addition of 5 grains of sulphate of potash, the globule of tin weighed only 6·6 grains, and the aqueous solution furnished an abundant yellow precipitate of stannic sulphide when mixed with hydrochloric acid. Since in the final confirmation of the presence of tin it is usual to fuse the supposed binoxide with cyanide of potassium, it is important, when using the commercial salt, to examine not only for metallic tin, but for any black sulphide separating during the solution of the fused mass in water, and for any yellow sulphide which may exist in the aqueous solution. Instead of using cyanide of potassinm, the ferrocyanide answers the purpose for reducing the stannic oxide, an alloy of tin and iron being obtained which dissolves in hydrochloric acid, and responds to the test with mercuric chloride.

Detection of Zinc in Qualitative Analysis.—The zinc precipitates are all white, and the well-marked characters of the sulphide are so easily obscured by the presence of traces of foreign metals, that the detection of this element is often surrounded with practical difficulties; and even if the coloured reaction with nitrate of cobalt on charcoal be resorted to, as a confirmatory test, the indications are, from the same cause, not always deemed satisfactory. The author recommends a modification of the ordinary course of analysis to meet such cases; the supposed sulphide of zinc is dissolved off the filter with hot dilute nitric acid, and the solution is mixed with a very small quantity of nitrate of cobalt (not even sufficient to impart a pink colour), the whole is then precipitated by carbonate of soda employed in slight excess, boiled for a minute or two, and the product collected on a filter, washed, dried, and incinerated on platinum foil. The green colour, if not already apparent, becomes visible upon crushing the residue moistened with a little water under a glass rod. By quantitative experiment it was demonstrated that sulphide of ammonium is a more sensitive reagent to be employed in the detection of zinc than the ferrocyanide of potassium, and that by this means $\frac{1}{10000}$th part of zinc in solution can be identified.

Detection of Magnesium.—When proceeding to test for magnesium in the filtrate from the ammonia and sulphide of ammonium precipitates in the ordinary course of analysis, it is usual to add phosphate of soda, and look for the formation of a crystalline precipitate of the ammonio-magnesian phosphate, but frequently a slight flocculent precipitate makes its appearance at once, and obscures the magnesian reaction. The author asserts that this is phosphate of alumina, and its occurrence in this place (not alluded to in treatises upon qualitative analysis) is due to the slight solubility of alumina both in ammonia and sulphide of ammonium.

Mineral Constituents of Filter Paper.—The errors from this source may frequently be disregarded, but in critical analyses where the solutions operated upon have to be many times subjected to processes of filtration, and possibly a whole sheet of paper thus consumed, it is desirable to take these matters into account. The author made a careful analysis of a large quantity of the ash of an ordinary quality of white filtering paper, bearing the name of "J. McA. and Co.," and found it to consist chiefly of silica and alumina (clay), with smaller quantities of the carbonates of lime and magnesia, and ferric oxide. There were also present the sulphates of lime, potash, and soda, and traces of phosphoric acid, oxide of cobalt, and oxide of lead. It is usual to make an allowance for the weight of the ash in quantitative analysis, and the author believes it to be equally necessary to make an examination of the mineral constituents of the paper before employing it in exact qualitative analyses.

A short discussion ensued, in which Dr. Odling stated his conviction that the formula adopted by Prof. Bloxam, in explaining the constitution of the cupr-ammonium sulphide, was at variance with all the analogies of sulphur. It was not possible for the compound to contain an uneven number of sulphur-atoms, and he regretted that a physical examination of a substance of this character could not be made, but in other instances, where such corroboration could be readily obtained, it had been found that the vapour-volume and specific heat supported the di-equivalentic value of this element.

Professor Bloxam admitted that his sulphur determinations were not so close as he should have wished, but for the eight-atom formula (instead of S_7) the amount of 61·12 per cent. of sulphur was demanded.

The President offered a few observations upon the general question of nomenclature, and proposed a vote of thanks to Prof. Bloxam, which was warmly responded to. The meeting was then adjourned until Thursday, May 4.

PHARMACEUTICAL MEETING.

Wednesday, April 5.

Mr. T. H. Hills, *Vice-President, in the Chair.*

Mr. Haselden read a paper "*On Resina Jalapæ, P. B.*" The author prepared the resin both from sound and worm-eaten root, and found that the sound root yielded the largest amount, thus disproving the assertion of Christison and Pereira that the worm-eaten root is the best for the preparation of the resin. He also experimented upon Tampico as well as Vera Cruz jalap, and found that the former yielded as much resin as the latter. When methylated spirit was employed in making the extract the author found that it was impossible to get rid of the disagreeable methylic odour. The sulphuric acid test, he showed, would not distingush between scammony and jalap resins, both giving a rose colour.

Mr. Tilden remarked that Spirgatis had recently shown that the resins of jalap and scammony give the same colouration with sulphuric acid, and that their chemical properties resemble each other so closely as to lead to the conclusion that the active principles are identical—a conclusion which is supported by the fact that the plants yielding them belong to the same natural order.

Professor Redwood then read a paper "*On the Construction of a Pharmacopœia.*" The Professor objected to the division of the Pharmacopœia into two parts, one containing the Materia Medica, and the other the preparations and compounds. He suggested the amalgamation of the two parts, as made in several foreign pharmacopœias, in which all the articles ordered, excepting those used as tests and reagents, are arranged in alphabetical order, and included in one category. The adoption of this arrangement would bring all preparations of a sort together, just as they are at present. But besides this classification under the respective heads Aquæ, Cataplasmata, &c., there is another, very important to the medical man, which is to have appended to every medicine a list of the preparations into which it enters. Thus, under the first article, gum acacia, we should have

Preparations containing Gum Acacia.

Mistura Guaiaci	1 part in 85
Mucilago Acaciæ	1 part in 2½
Pulvis Amygdalæ compositus .	1 part in 13
Pulvis Tragacanthæ compositus .	1 part in 6

Etc., etc.

With regard to the nomenclature used, the Professor said it should be as far as possible adapted for all time, and if once established should not be rashly changed. A pharmacopœia, he thought, should occupy neutral ground with reference to chemical theories, and the use of chemical names and symbols be as far as possible avoided. Referring to the mercurial compounds, calomel and corrosive sublimate, he remarked that the amount of chlorine combined with the mercury in these bodies was twice as great in one case as in the other, and thus a simple relationship between the two bodies was established. The name subchloride, applied to calomel, indicated its position among the chlorides of mercury, as containing the smaller proportion of chlorine. It is preferable in this respect to the name chloride, as being more explicit, and leaving no doubt as to which of the chlorides is meant. He suggested also that the name "Hydrargyri perchloridum" should be applied to corrosive sublimate, the prefix "per," as used in such a case, being perfectly well understood to signify the compound containing the largest proportion of chlorine. In the case of the protoxide of mercury, the Professor advocated the use of the name "Hydrargyri oxidi rubrum," a name which would be good for all time. After referring to the difficulties at present in the way of assigning absolute formulæ to chemical compounds in general, the Professor proceeded to the consideration of the weights and measures employed, and remarked that while the adoption of the avoirdupois weights is likely to produce a more uniform and correct preparation of the medicines in large quantities, the old apothecaries' weights are much better adapted for prescriptions. The quantities represented by these weights, and the relations they bear to each other, are, if not the best that could be devised, at least the best that have been introduced or suggested. They are easily written, perfectly characteristic, and readily distinguished, not only from each other, but also from other parts of the writing of a prescription. In continuation, the Professor advocated the extended recognition of well-established forms of remedies in a pharmacopœia. He suggested that, among "granular" and effervescent medicines, for example, whatever is good and essential should be sought out from among the varied extrinsic qualities given to such preparations for mere trade purposes. The form of lozenge he thought promised successful extension for giving an agreeable character to medicines; and for external remedies he thought plasmata might often replace ointments. He suggested, however, the name "Glycemata" instead of plasmata. Thus the original preparation of starch would be glycematum amyli, which he would shorten to glycemylum, and other solutions in glycerine would receive a similar name. The use of glycerine as a solvent he thought might be advantageously extended in medicine.

Owing to the lateness of the hour only a short discussion followed the reading of this important paper—important as, perhaps, foreshadowing some of the alterations that may be looked for in the edition of the Pharmacopœia —or, rather, new Pharmacopœia—now in preparation.

Dr. W. S. Squire objected to the arrangement proposed by Dr. Redwood. He thought the best arrangement was that in which the descriptions of all the preparations of an article were given in connexion with the article itself. This was the arrangement in the "Companion to the Pharmacopœia." He wished chemical symbols and formulæ to be retained, and differed entirely from the Professor on the subject of weights and measures. The introduction of new substances, he thought, involved considerable difficulty, and he objected to Plasmata, as they would not mix with ointments.

Mr. D. Hanbury said that there were two classes of people who were greatly interested in a Pharmacopœia—namely, physicians and pharmaceutists, who desired to know the composition of medicines, and the best methods of preparing and identifying them. The object of the work was to supply this information to these two classes of persons, and he thought it undesirable to introduce extraneous matter. The Pharmacopœia was not intended to be a work for teaching chemistry, and still less botany and zoology, but for giving the necessary instructions for the preparation of medicines in the best, most efficient, and economical way; and the information given should be conveyed in plain language, that could be readily understood by those who had occasion to refer to it.

Drs. Edwards and Attfield both expressed an opinion that the Pharmacopœia should indicate what system of chemistry was recognised, so that teachers of pharmaceutical students might know what course to pursue.

The meeting (the last of the season) then adjourned.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

April 4th, 1865.

R. Angus Smith, *Ph.D., F.R.S., &c., President, in the Chair.*

A communication was read entitled "*An Instance of the Injurious Action of Alkalies on Cotton Fibre,*" by Messrs. Heinrich Caro and William Dancer. A remarkable instance of the deleterious action of alkali on cotton fibre has lately come under our notice, when examining some indigo prints which had been stiffened or finished with silicate of soda, and kept in bales during about two years. The strength of the fibre of the greater part of these goods had decreased to about one-third of the strength of some pieces which had been packed in the same bales, and which differed in no other respect from the others except in their having been finished with starch. We therefore surmised that silicate of soda had been the primary cause of the deterioration of the goods. Further observations convinced us, however, that the injury was due to the long-continued action of free or carbonated alkali upon the cotton fibre. Some of the sound pieces (which, as before mentioned, had been finished with starch) had been packed between the silicated goods, and had abstracted soda from them, which had penetrated from the places of contact into the interior of the pieces to a considerable depth. In the same ratio in which the pieces had taken up soda it was found that they had diminished in strength. On the other hand, it was found that in such places of contact the silicate of soda of the silicated goods had suffered a partial decomposition, extending to the depth of four or five layers of the pieces. The silicate of soda in the middle of the pieces contained from 70 to 74 per cent. of silicic acid, combined with from 30 to 26 per cent. of soda; whilst the analysis of the silicate of soda contained in the contact layers showed that from one-third to two-thirds of its soda had been abstracted. This loss of soda was accompanied by a change of strength of the cloth which appeared to bear some proportion to it; the layers or folds of the cloth *decreasing* in strength as they were removed from contact with the starched goods, until the silicate of soda attained the same composition as that found in the most rotten parts of the piece, this generally taking place about the fourth or fifth layer or fold of the piece, as before stated. The following table shows the changes in strength produced by this decomposition of the silicate of soda:—

	Finished with Starch.		Finished with Silicate of Soda.					
	Middle.	Contact Layer.	Contact Layer.	2nd	3rd.	4th.	5th.	Middle.
Strength ..	100	81	89	68	62	54	48	35

The silicate of soda had evidently been decomposed with the formation of free alkali and an acid silicate which appears to have very little action on the cotton fibre. In some places the decomposition had gone further, and free silicic acid had separated out in the form of a white powder upon the surface of the cloth. The same decomposition, accompanied by the same changes in the strength of the cloth, was observed upon all pieces which had been in contact with the paper used for wrapping the bales. In this instance the paper had absorbed the liberated soda, and the cloth in contact with it had almost entirely retained its original strength. The white portions of the patterns were in a further advanced state of decay than the blue ones, in most instances retaining only 10 per cent. of their original strength. In the goods finished with starch only, the whites were equally as strong as the blues. In the goods finished with silicate of soda the whites were almost as strong as the blues in all places where the before-mentioned decomposition of the silicate of soda had been accompanied by an abstraction of soda; but in the interior of the goods, where the silicate of soda had retained its original composition, the strength of the whites had decreased to about one-third of that of the blues. It was therefore evident that this excessive decay of the whites was due to some cause which had assisted the action of the alkali upon them, and we believe to have found an explanation of this in the action of the silicate of soda upon the sulphate of lead contained in them to the amount of about 10 per cent. of the mineral ash. Sulphate of lead has been an ingredient of the resist paste printed upon the places intended to remain white, and by the subsequent action of lime and sulphuric acid it has become fixed in the fibre. We have noticed that sulphate of lead decomposes solutions of silicate of soda very rapidly, with formation of sulphate of soda, free silicic acid, and silicate of lead. These changes give rise to the production of a crystallisable and strongly efflorescent salt, and to an increase in bulk; and we think that the mechanical effect produced by the crystallisation of the sulphate of soda formed may have caused a further and final disintegration of the fibre already weakened by the action of the alkali. Under the microscope the fibre of the white portions of the pattern presented the appearance of cylindrical tubes, partially covered with minute crystals (soluble in water); in some places these tubes appeared to be split longitudinally. A paper on the same subject was lately read before the Chemical Society of London by Dr. F. Crace Calvert, F.R.S. (See Chemical News, p. 113.)

A paper, entitled "*Remarks on the Microscopical Appearances of Cotton Hair During Dissolution in the Ammoniacal Solution of Copper*," was read by J. B. Dancer, F.R.A.S. The structure of cotton hairs has occasionally furnished an interesting topic for conversation at the meetings of our Microscopical Section. Two of our members, Mr. Chas. O'Neill and Mr. Heys, have given considerable time and attention to this subject. Mr. Walter Crum, F.R.S., communicated to the Chemical Society a memoir "*On the Cotton Fibre*," and the manner in which it unites with colouring matter. His paper is illustrated with some beautifully executed drawings of the microscopical appearances of cotton in the natural state, and when mordanted, mercerised, and treated with various dyes; this paper is well worthy the attention of those interested in this branch of inquiry. Mr. Crum has presented a copy of his memoir to this Society. His description of the ordinary appearance of the cotton fibre agrees so nearly with what I believe it to be, that I will take the liberty of referring to his printed paper.* To Mr. Crum's description I may add, that many specimens of cotton, especially on the cylindrical portion of the hairs, show traverse markings. At times these appear at tolerably regular intervals, they have been claimed as evidences of spiral structure; when, however, they are examined with magnifying powers of 1000 to 1200 diameters, they proved to be cracks in the external membrane. Other portions of cotton exhibit longitudinal furrows, irregular in length and direction, having a shrivelled appearance something like the bark of an aged tree. In gun-cotton the transverse cracks are very numerous. From an examination of transverse sections of cotton I incline to the opinion that there is an external membrane distinct from the true cell wall or cellulose matter. Inside the cellulose there is an irregular cavity. This, in some specimens (when viewed longitudinally), appears to contain granules, probably the remains of the organising fluid contents of the cell—the mucous matter which is seen in growing cotton as mentioned by Captain Mitchell in his letter to Mr. Hurst read at this Society March 22, 1864. On April 21, 1863, Mr. Chas. O'Neill made a communication to this section "*On the Appearance of Cotton Fibre during Solution and Disintegration*."† These experiments referred to the application of Schweizer's solution of copper and ammonia. Under the action of this solvent Mr. O'Neill considers that cotton exhibits spiral vessels situated either inside or outside the external membrane. In a paper read by the same gentleman on May 18, 1863, it is stated that spiral vessels are seen during the solution of gun-cotton in ether and alcohol. On December 21, 1863, Mr. Heys read a paper before this section, in which he refers to spiral vessels in cotton hairs which seem to prevent the collapse of the tubes. The announcement of the discovery of spiral vessels excited my curiosity. Having often examined varieties of cotton under the microscope without suspecting any such structure, I was naturally desirous of witnessing its appearance during dissolution. A careful examination of cotton in the copper solvent, with powers varying from 50 to 1200 diameters, showed me the appear-

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* *Journal of Chemical Society*, p. 404, vol. i., series 2.

† Chemical News, vol. vii., p. 223.

ances described by Mr. O'Neill. I could not, however, endorse his interpretations of them. On January 16, 1865, I sent a letter to the Chairman of the Microscopical Section, stating my belief that the spiral appearances could be clearly traced to a mechanical action which the solvent exerted on the vegetable cell, and that at some future time I hoped to illustrate this to the members of the section. Since December last I have subjected cotton during microscopical examination to a variety of influences in acids, alkalies, metallic solutions, iodine, and also gun-cotton in varied proportions of ether and alcohol. Repeated experiments tend to confirm my disbelief in the existence of spiral vessels, properly so called, either inside or outside cotton hairs. It would be difficult to explain by means of drawings how these pseudo-spirals are created, and I have, therefore, supplied a number of microscopes for the purpose of showing at the close of the meeting the actual appearances. Some of the gentlemen present have witnessed these experiments; but for the benefit of those who have not I shall attempt a brief explanation, to enable them to comprehend more readily what they will see under the microscopes. In order to observe the action of the copper solvent on cotton, place a few hairs about a quarter of an inch in length on a glass plate, and cover them with thin glass; it is useful to rub a little beeswax on the glass plate in such a manner as will just support the covering glass to prevent too great a pressure on the cotton; then arrange the cotton under the microscope with a power of not less than 200 diameters. The solvent should be applied by a glass pipette to the edge of the covering glass whilst the observer is looking through the microscope (this is important). If the solvent is very strong, the action is too rapid for the eye to follow; if of moderate strength it will be seen that as soon as the solvent comes into contact with the cotton in the field of view, a rapid rotation or twisting of the hairs takes place. In my opinion, it is this rotating action which brings about the appearances which have been mistaken for spiral vessels. The explanation which I have to offer for the phenomenon is this: first, we have the external membrane of the cotton, then the cellulose and primordial utricle, and finally, the dried contents in the cell, which I take to be the remains of the organising fluid. Observation shows that the external membrane is not elastic and only partially soluble. The cellulose is exceedingly elastic and soluble, and expands to a remarkable degree in the act of dissolution. The contents of the cell behave in a similar manner to that of the external membrane; it is neither elastic nor very soluble. The most successful experiment is made by allowing the copper solvent to come at once into contact with some length of the cotton hair. The solvent permeates some parts of the external membrane more easily than others, and causes a rapid expansion of the cellulose, which bursts the external membrane, and as this action is taking place at various portions of the same hair a tangential force is exerted which twists and contorts the cotton in the direction of its length, and thus a spiral appearance is given to the whole structure of the cell. The non-elastic external covering is twisted round the expanded cellulose, sometimes as a single band, at others like a bundle of fibres. In those parts where the external covering has given way all round the hair, the cellulose expands into a bulb, pushing back the external membrane into a series of folds which form a ligature, and resists the expansive force of the cellulose. A number of these ligatures cause the expanded cellulose to assume the appearance of a string of beads. The lateral expansion of the cellulose contracts the length of the hair, and this causes the contents in the cavity of the cell to assume a corrugated appearance; this corrugation has also been subjected to the twisting power along with the other parts of the cell, and thus its spiral appearance is produced. What becomes of the primordial utricle, I cannot state with certainty. After the disappearance of the cellulose there is an envelope left, which surrounds the contents of the cavity, this may be the primordial utricle, or the film left by the drying up of the protoplasmic or organising fluid. If the solvent is made to come into contact with the ends of recently-cut cotton a beautiful trumpet mouth is produced —the exposed surface of cellulose has expanded and pushed back the external covering into folds—the contents of the cell may, in this case, be seen projecting from the mouth of the trumpet form. Long after the complete dissolution of the cellulose has taken place, the external membrane remains just as the rotation or twistings had left it, some portions in the form of rings, which had been the ligatures between the bulbous expansions, other portions as irregular spirals. The cell contents also remain as twisted corrugations. From the observed difference in solubility between the cellulose and the external and internal matter, I should imagine a difference in constitution. A few experiments have led me to suspect that some of the spiral appearances observed in hemp and flax fibres during dissolution may possibly be caused by the mechanical action of the solvent employed. P.S.—In making the cupric oxide with ammonia, the oxide of copper requires a thorough washing before dissolving in the ammonia. The presence of any salt of ammonia, even in very small quantities, interferes with its power in dissolving cotton.

(To be continued.)

ACADEMY OF SCIENCES.

April 17, 1865.

M. E. Martin presented a memoir entitled "*An Electro-chemical Study of real Simple Bodies, Ponderable and Imponderable, divided into Two Classes by Peculiar Affinities.*" The author has arrived at a new science of electro-chemistry based on the following assumptions, or, as he regards them, proved facts:—1. That the two electricities are not forces, but simple material bodies endowed with chemical properties, by virtue of which they form compounds with simple ponderable bodies. 2. That the two electric fluids of the battery are not produced by any physical action, but by a chemical action of the ponderable bodies which hold them in combination, and which by uniting with each other set the electricities at liberty. 3. That these same electricities collected by conductors, and transmitted in currents, participate directly in the actions they produce, and combine chemically with the elements they disunite. We may give the author's views at length on some other occasion; at present we may quote the decomposition and composition of water as an illustration of his ideas. Negative electricity he distinguishes as *electrile*, and gives it the symbol El; positive electricity is *etherile*, symbol Et. The formula of hydrogen becomes therefore HEl, and that of oxygen OEt. The two electricities arriving at opposite poles attracts in the decomposition each its proper element, and we have

$$\mathrm{HO} + \mathrm{El} + \mathrm{Et} = \mathrm{HEl} + \mathrm{OEt}.$$

The two electricities in uniting with each other produce caloric, symbol C^*, and light, L^*. Here, then, are the essential principles of electro-chemistry: two electricities possessing peculiar and invariable affinities which unite with each other to form two *imponderable compounds*, heat and light, and with simple ponderable bodies also endowed with peculiar affinities of two kinds. We have thus two classes of bodies:—1. *Oxic*, which includes electrile, an imponderable body, and six ponderable elements, oxygen, fluorine, chlorine, iodine, bromine, and nitrogen; 2. *Basic*, which includes etherile, a simple imponderable body, the basic metalloids, hydrogen, carbon, boron, phosphorus, sulphur, selenium, and silicium, and all the metals. The author concludes—until now chemists have only recognised the effects of chemical union, but have never before discovered the cause—now the cause is manifest; bodies of the same kind are indifferent to each other, but they unite themselves with all bodies of the opposite kind, and the fundamental law of chemical union thus rests upon the duality of the kinds of simple bodies.

M. Houzeau presented a memoir "*On the Influence of the Seasons on the Properties of Atmospheric Air.*" The author has exposed ozone papers at Rouen for several years, and has found that the chemical activity of the air reaches its maximum in the spring (May and June), diminishes in the summer, and in the autumn almost disappears. It reappears, however, in winter, and becomes specially appreciable in March. The author remarks on the coincidence of this chemical exaltation with the *awakening of nature*, and suggests the study of it to physicians and farmers, who may, he thinks, make discoveries profitable to hygiene and agriculture.

M. Nickles presented a note "*On the Combinations of Boron with the Halogens.*" An alcoholic solution of boracic acid treated with a current of dry chlorine or hydromic acid exchanges oxygen for chlorine or bromine, and forms a chloride or bromide of boron, which remains, however, in combination with organic molecule. A solution of anhydrous boracic acid in absolute alcohol, for example, absorbs hydrochloric acid with avidity; the liquid becomes oily, and fumes in the air. Water decomposes it, reproducing hydrochloric and boracic acids and alcohol. It is not volatile, although the vapours given off contain some chloride of boron. The liquid appears to be merely an alcohol solution of boracic acid saturated with chlorine; and yet, according to the author, it always presents a constant composition, exactly expressed by the formula

$$3BoO_3,3HCl+5(C_4H_6O_2).$$

When heated, it gives off torrents of boraciferous hydrochloric acid; the thermometer rises rapidly and stops at 85°. The residue is boracic acid. The volatile part is hydrated chloro-boracic ether, having the formula

$$BoCl_3+5(C_4H_5O)+9HO.$$

Hydrobromic acid gives almost similar results. Alcohol saturated with boracic and hydrobromic acids yields a distillate which, rectified at 115°, may be represented as

$$BoBr_3+13(C_4H_6O_2)+3HO\text{; or rather,}$$
$$BoBr_3+13(C_4H_5O)+16HO.$$

The above compounds resemble each other in having a corrosive biting taste, in evolving white fumes which deposit boracic acid on surrounding objects, and which colour some woods and turmeric paper brown. From them by distillation with alcohol, the boracic ethers obtained by Ebelmen and Bouquet with alcohol and chloride of boron, may be procured, and thus the necessity of preparing chloride of boron is avoided. The new compounds behave with peroxides like ether charged with hydrochloric acid—that is, they change the peroxides into perchlorides, but the author argues against the ethers containing an hydracid.

M. Reboul presented a note on a "*New Carbide of Hydrogen derived from Amylene by the Subtraction of H_4.*" When crude bromide of valerylene (a mixture of di- and tetra-bromide) is distilled there passes at 45° to 50° a small quantity of a light mobile liquid, the new hydrocarbide *valylene* $C_{10}H_6$. It has at once the odour of garlic and prussic acid, and is hexatomic. When treated with ammoniacal cuprous chloride it forms a deep yellow compound $C_{10}H_5Cu_2$, which decomposes with some violence when heated, leaving a carbonaceous residue.

Evening Instruction in Practical Chemistry.—We may again call attention to the Birkbeck Course at University College, which commences on May 2. It is open to all engaged in manufactures at a reduced fee.

NOTICES OF BOOKS.

Practical Chemistry. By Stevenson Macadam, Ph.D., F.R.S.E., F.C.S., &c. London and Edinburgh: W. and R. Chambers. 1865.

"This treatise," says the preface, "is intended for the use of students in medicine and arts, and of advanced pupils in educational institutions. It is arranged in as simple a manner as possible, and the tests and processes given in the work are restricted to those substances which are to be met with in every-day life. The treatise may be regarded as introductory to the larger works on the same subject, and in the hands of an intelligent teacher will serve as a guide to the conduction of classes in practical chemistry."

We need only express our opinion that the book will prove very useful as an introductory work, and strongly recommend it to pupils and teachers.

Chemical Technology; or Chemistry in its Applications to the Arts and Manufactures. By Thomas Richardson, M.A., Ph.D., &c., and Henry Watts, B.A., F.C.S. Second Edition. Vol. I. Part 4. London: Baillière. 1865.

[third notice.]

The previous articles have given our readers some idea of the various contents of this useful volume, but a number of very important manufactures described therein still remain to be noticed. The first we come to is chlorate of potash, but about this salt there is little to be said. We need only quote one process,—the best, and that most usually employed. It consists in passing excess of chlorine into a mixture of caustic lime and solution of chloride of potassium contained in close leaden tanks. The reaction which takes place in the operation is represented by the following equation:—

$$KCl+6CaO+6Cl=KO,ClO_5+6CaCl.$$

At the end of the operation the solution obtained is filtered, evaporated nearly to dryness, the mass redissolved in hot water, and set aside for the chlorate of potash to crystallise. The chloride of calcium of course remains in the mother liquor, and is usually precipitated by carbonate of soda to yield the *creta precipitata*, so extensively used by pharmaceutists and cosmetic makers.

The uses of chlorate of potash are now very numerous, but the most important is in the manufacture of lucifer matches, to which we shall refer presently. Besides this, the salt is largely consumed in compositions for coloured fires, some receipts for which mixtures are here given; that for crimson light is as follows:—

Dried nitrate of strontia . . .	40
„ Chlorate of potash . . .	6
„ Fine charcoal	2
„ Sulphur	13

The sulphur is here directed to be wetted before admixture, but it is better to make the mixture by sifting the ingredients together. It should have been said, also, that red fire made with strontia is, for some unknown reason, liable to spontaneous ignition, and therefore ought only to be made as required.

Incidentally, it is said that chlorate of baryta, which is used for green fire, is formed by passing chlorine into a thick milk of carbonate of baryta at a temperature of 200° or so, whereby the whole mass is changed into chlorate of baryta and chloride of barium.

The history of few manufactures is more interesting than that of phosphorus and its applications. That body, looked upon not much more than a quarter of a century ago as a dangerous chemical curiosity, is now a necessity in every household. Sold not many years ago at four guineas a pound, its price has fallen to as many shillings;

and whereas England once imported nearly all the phosphorus consumed here, we now supply the greater part of the world with it.

Phosphorus is procured by one of the simplest of chemical processes, the reduction of phosphoric acid by carbon. The phosphoric acid is of course obtained by treating bone ash with sulphuric acid. After concentration to a syrupy state it is mixed with wood charcoal, and the mixture is dried and powdered. It is then distilled in clay retorts, the necks of which dip under water. The crude product is afterwards purified by re-distillation. The different stages of this process are excellently described in the book under notice, in which also drawings of the apparatus and arrangements are given. The manufacture of amorphous phosphorus also receives its share of notice, and the account of the process is illustrated by drawings from Mr. Albright's specification.

A long and useful account of the manufacture of lucifer matches naturally follows, of which we need only say that the reader will find all the information necessary for him to set up the trade if he should feel inclined.

We pass to another use of phosphorus in phosphatic manures, of which the authors give a very good account, after a brief notice of phosphates in general. We must refer the reader to the work itself for a number of useful analyses of phosphatic minerals, and we may remark in passing that on this and other subjects the authors have shown a commendable industry in collecting analyses from many sources. These are often of great assistance to chemists, and serve to some extent as guides to the merchant and manufacturer.

We need not detain our readers over the manufacture of superphosphate, but will quote for their information some analyses of samples, the first two of which are reported as of inferior, and the last two as of excellent quality:—

	I.	II.	III.	IV.
Water . . .	14·40	13·79	10·80	0·91
Organic matter . .	8·91	15·00	4·21	—
Soluble phosphate .	3·60	2·84	20·28	25·70
Bone earth rendered soluble by acids.	(5·61)	(4·43)	(31·63)	(40·11)
Insoluble phosphate .	6·83	25·54	4·11	6·68
Sulphate of lime .	44·23	26·33	46·63	55·43
Alkaline salts (mostly common salts)	2·52	4·36	10·78	7·96
Insoluble siliceous residue	19·51	12·14	3·19	2·32
	100·00	100·00	100·00	100·00
Percentage of nitrogen equal to	1·44	2·43	0·34	—
Ammonia . . .	1·75	2·91	0·41	—

For the estimation of phosphoric acid in coprolites, bone ash and manures, the authors give the following process, which they say is both expeditious and accurate:—

"The substance is dissolved in as small a quantity of hydrochloric acid as possible, excess of ammonia is then added, the precipitate redissolved in acetic acid, and some acetate of ammonia added to the solution.

"A solution of acetate of uranium, made by dissolving ammonio-carbonate of uranium in acetic acid, is finally added, and the solution boiled.

"A greenish-yellow slimy precipitate falls, which contains the whole of the phosphoric acid. It requires, from its character, the following treatment:—Set aside the hot solution on a sand heat, and allow it to settle completely; decant, add more water, boil, and so forth, until the precipitate has assumed a crystalline appearance, when it may be cast on a filter, without fear of choking the pores, and well washed.

"The precipitate is dried and ignited, when the ammonia is expelled, and lemon-coloured phosphate of sesquioxide $2U_2O_3,PO_5$ remains. This precipitate is allowed to cool, moistened with nitric acid, re-ignited, and weighed."

We have before alluded to the practice of requiring a chemist to give a valuation of a manure from his analysis. The practice is an eminently absurd one, but if it be continued, it would be well if chemists would agree to uniform data. We find in this work the data per ton in pounds sterling adopted by several chemists for superphosphates, and quote them more for the amusement than the instruction of our readers.

	Anderson.			Nesbit.			Way.			Hodges.			"North British Agriculturist."			Voelcker.		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
Ammonia . .	60	0	0	60	0	0	50	0	0	50	0	0	56	0	0	60	0	0
Insoluble phosphates . .	7	0	0	8	0	0	7	0	0	7	0	0	7	0	0	10	0	0
Soluble phosphates . .	30	0	0	24	0	0	32	0	0	25	0	0	23	0	0	30	0	0
Biphosphate of lime . .	46	16	0		—			—			—			—			—	
Alkaline salts .	1	0	0	1	0	0	1	0	0	1	0	0		Nil		1	5	0
Organic matter .	0	10	0	1	0	0	1	0	0	0	10	0		Nil		0	10	0
Sulphate of lime	1	0	0	1	0	0		Nil			Nil			Nil		1	5	0

Now, if a manure maker should adopt Dr. Voelcker's standards, and a farmer consult Mr. Hodges, there would be occasion for a pretty dispute.

The following remarks on this subject deserve the attention of both chemists and manufacturers:—"The difference in the data adopted by chemists can only be explained by the fact that, being neither merchants nor manufacturers, they have, to a certain extent, founded their data upon theoretical assumptions. Some makers use common salt; others employ sulphate of soda; and yet some of the chemists lump them all under alkaline salts at 1*l.* per ton, while one party considers them of no value at all. Again, the cheapest drier a manufacturer can use is sawdust, which cannot be purchased under 1*l.* per ton; and yet it is generally stated to be worth only 10s. Lastly, no allowance is made by any party for the expenses of mixing, bags, &c., &c. We believe that the manufacturers have many just grounds of complaint as to the arbitrary way in which their produce is now valued, and it would be to their advantage to combine together to introduce a more correct system into their trade."

As far as concerns chemists, we believe it would be well for them to confine themselves to stating the results of their analyses, and leave the manure maker and the farmer to settle the price of the article.

NOTICES OF PATENTS.

1686. *Improvements in the Smelting or Reducing of Lead Ores, and in the Refining and Softening of Lead.* J. H. Johnson, Lincoln's Inn Fields, London. A communication. Dated July 7, 1864.

For assisting the reduction of lead from galena and other ores of that metal it is proposed to use scraps of tin plate, by which means a superior quality of metal is said to be produced at less cost. The second part of the invention refers to a process of purification, whereby it is intended to remove the copper, antimony, and other metals from hard lead by throwing sulphur or metallic sulphurets into the reverberatory furnace in which such metal is already melted.

1688. *Cleansing or Clarifying Impure Water.* W. E. Newton, Chancery Lane, London. A communication. Dated July 7, 1864.

The agent to be used for this purpose is an aqueous solution of persulphate of iron, made as neutral as possible, which is to be added to the impure water in such proportion that the ferric oxide thereby precipitated may carry down with it all the suspended and part of the dissolved impurities.

This proposition is very similar to that patented many years ago by Dr. Medlock, who employed metallic iron, which by rusting under water furnished the necessary hydrated peroxide.

1669. *Manufacture of Aniline Colours.* G. Phillips, Holborn Hill, London. Dated July 5, 1864. (Not proceeded with.)

In the production of lilac and purple dyes from aniline or its homologues the inventor heats these bases with arsenic acid and protosulphate of iron. It is recommended to mix 200 parts by weight of arsenic acid with half that amount of aniline, and to add a like proportion of crystallised sulphate of iron. These ingredients are first dissolved in water, and the solution is boiled down with the aniline until the whole or nearly the whole of the water has been evaporated. The residual mass is then exposed to the temperature of 350° or 400° Fahr. for a period of about four hours, and the colouring matters may then be extracted by digesting with alcohol or methylated spirit, and purified, if necessary, by any of the methods commonly known and employed.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

712. R. A. Brooman, Fleet Street, London, "Improved process for the production of photographic images capable of being inked with fatty inks." A communication from C. M. T. du Motay and C. R. Maréchal, Metz, France.—Petition recorded March 14, 1865.

892. S. Childs, Malcolm Villa, Putney, "An improved method of treating fatty matters."—March 29, 1865.

899. W. Brookes, Chancery Lane, "A new or improved mode of rapidly reducing, cementing, and melting iron and other ores, also iron slag or cinders, dross, and scales or crust, to produce directly therefrom steel or malleable or cast-iron."—A communication from J. B. Helson, Hautmont, France.—March 30, 1865.

957. J. Player, Norton, Stockton-on-Tees, "Improvements in the manufacture of balls, blooms, or slabs of malleable iron or steel."—April 4, 1865.

804. A. Paraf, Glasgow, N.B., "Improvements in dyeing and printing cotton or linen fabrics or yarns."—March 22, 1865.

864. F. Le Roy, St. Saulve, France, "Certain improvements in non-conducting compositions for preventing the radiation or transmission of heat or cold."—March 27, 1865.

900. A. A. Croll, Coleman Street, London, "Improvements in the manufacture of sulphate of alumina."—March 30, 1865.

945. J. R. Wigham, Monkstown, Dublin, "Improvements in the means and apparatus employed for illuminating lighthouses."—April 4, 1865.

966. W. Teall, L. Lepaige, and E. T. Simpson, Wakefield, Yorkshire, "Improvements in the manufacture of lubricating oil and grease." A communication from E. Lepaulle, Paris.

970. E. Ritherdon, Fenchurch Street, London, "Improvements in protecting iron ships and other submerged structures from oxidation and corrosion."—April 5, 1865.

979. M. Diosy, Fenchurch Street, London, "A new or improved material to be used in combination with or as a substitute for coffee." A communication from R. C. J. Prevet and M. L. J. Chollet, Paris.—April 6, 1865.

1011. A. G. Hunter, Rockliffe Hall, near Flint, "Improvements in the manufacture of soda and potash."—April 8, 1865.

Notices to Proceed.

3020. J. G. Winter, Chester, "Improvements in revolving retorts, and in the mode of applying heat to the same, designed for producing oil from coals, shales, cannels, and other substances, or for distilling oils."—Petition recorded Dec. 5, 1864.

3080. F. G. Mulholland, Essex Street, Strand, "Improvements in purifying resin or other substances of a similar kind and character."—Dec. 13, 1864.

3095. J. B. Thompson, Rothwell Street, Regent's Park Road, "Improvements in coating iron and steel with silver, gold, platinum, or palladium, and in ornamenting articles with such metals."

3101. P. F. Lunde, Jewry Street, Aldgate, "Improved apparatus for obtaining extracts from vegetable substances."—Dec. 14, 1864.

3147. H. F. McKillop, Belvedere, Kent, "Improvements in compositions for coating or covering ships."—Dec. 19, 1864.

3222. J. R. Breckon, Darlington, and R. Dixon, Crook, Durham, "Improvements in the construction of coke ovens."—Dec. 28, 1864.

306. J. R. Webb, Hibernia Chambers, London Bridge, "A new or improved method or process and apparatus for obtaining the concentrated extract of hops, and for preserving the same from deterioration."—A communication from G. Percy, W. Wells, C. Brown, J. Mulford, and J. M. Webb, New York, U.S.A.—Feb. 13, 1865.

574. C. J. Falkman, St. Petersburg, "Improvements in apparatus for distilling, purifying, and storing spirituous liquors."—March 1, 1865.

591. C. Rahn, Brook Street, Grosvenor Square, "An improved instrument for concentrating light, applicable to dental, surgical, and other operations."—March 2, 1865.

617. A. Akeroyd, Bradford, Yorkshire, "An improved process and apparatus for dyeing and preparing cotton, worsted, and silk warps."—March 4, 1865.

861. C. J. L. Leffler, Broad Street Buildings, London, "Improvements in casting ingots of steel and malleable iron."—March 27, 1865.

880. E. Savage, West Meriden, Conn. U.S.A., "Improvements in hardening and tempering steel."—March 28, 1865.

CORRESPONDENCE.

Continental Science.

Paris, April 25.

I have no wish to be an alarmist, but it is my duty to inform you that the Academy of Sciences has received intelligence of the outbreak of a new epidemic. Coming as the news does before the Russian plague or fever, or whatever it is, has been disposed of, the information is not cheering; but there is this comfort, that, so far as I know at present, the epidemic I am about to mention is not migratory. It has broken out in Savoy, where happily it remains. There, it seems, it attacks preferentially the inhabitants of the mountains—the poorest people; but it does not altogether spare the richer folk in reputedly healthy districts. Those who lead sedentary and indoor lives are first attacked; outdoor work seems to save people. It is not contagious. I should have said that the disease is not altogether new. There has been an outbreak every winter—since when, do you think? Since the introduction of iron stoves into Savoy! Where these are not in use the disease remains unknown, and just as they are few or many in a neighbourhood the number of attacks rises and falls. Out of 2600 patients seized, not one has been discovered who had not been recently within the influence of an iron stove. I am sorry to say that we have not at present any account of the symptoms of the malady, of which we shall no doubt hear more. Some people are disposed to attribute it to the formation of carbonic oxide, which MM. Regnault and Chevreul will not believe is formed under the circumstances. The former gentleman ascribes the disease to the neglect of ventilation, explaining that animal exhalations and miasmata become incompletely decomposed in contact with the hot sides of a stove, and give rise to volatile or gaseous products, which remain in the room, and exercise a pernicious influence on the health of the inhabitants. M. Faye recommends an immediate investigation of the matter by the Commission on Unhealthy Trades; so the doubts about the origin of the disease will be cleared up soon.

A M. Pelon has invented a new heating apparatus adapted to the warming of railway carriages. He calls it a heat-generator. It consists of a cone of wood, which is covered with hemp, and which is made to revolve with great speed within a hollow cone of copper. These are enclosed in a metallic vessel, through which air is passed, and becoming heated in the passage, is then conveyed to the carriage. The inventor proposes to place a generator outside each carriage; motion will be given to the wooden cone by one of the axles of the carriage, and the heated air will be admitted to the vehicle by an arrangement under the control of the passengers. M. Pelon, like every sanguine inventor, thinks his machine capable of very extensive application, asserting that large mills could be more cheaply warmed by his apparatus than by fires. In the meantime, and pending more extended trials, he exhibits a little machine which keeps chocolate hot.

MISCELLANEOUS.

Chemical Society.—The next meeting of this Society will be held on Thursday evening next, at eight o'clock, when the following paper will be read:—"On Phosphite of Magnesium," by Mr. T. P. Blunt.

Royal Institution.—The following are the arrangements for the ensuing week:—Monday, May 1, at 2 o'clock, annual meeting. Tuesday, May 2, at 4 o'clock, Professor Frankland, "On Organic Chemistry." Thursday, May 4, at 4 o'clock, Professor Frankland, "On Organic Chemistry." Friday, May 5, at 8 o'clock, Professor Henry Fawcett, M.A., "On Wealth and those who produce it." Saturday, May 6, at 4 o'clock, Professor Bain, "On the Physical Accompaniments of Mind."

The Actonian Prize.—We are informed that the sum allotted to Mr. G. Warrington was 100*l.*, not 200*l.*, as stated in our last number but one. No second prize was adjudged.

Fire Damp in Collieries.—Mr. G. F. Ansell, of the Royal Mint, proposes a novel application of Professor Graham's law of gas diffusion for the purpose of ascertaining and giving warning of the presence of accumulations of fire damp in coal mines. The apparatus is susceptible of modification, but always consists of two parts, one being an air receptacle, made either of thin india-rubber in the form of a ball, or of glass with a permeable diaphragm of graphite, plaster of Paris, or porous earthenware. The remaining part of the apparatus is purely mechanical, and is intended to serve as an alarum, being either a simple lever with bell attached, or an electric signal communicating with the manager's office. The form of apparatus particularly described by Mr. Ansell is that of a glass U tube, having one aperture closed with a plate of graphite or equivalent porous diaphragm, and a few inches of mercury in the bend. If such an arrangement, filled in the first instance with air, be placed under the influence of an atmosphere containing five per cent., or even less, of light carburetted hydrogen or marsh gas, the presence of such admixture will be instantly detected by the passage of the gas through the interstices of the graphite, and the consequent expansion in volume of the gaseous contents of the tube; the column of mercury then rises in the opposite limb of the apparatus, and is made to record itself either by completing the circuit of a voltaic alarum, by deflecting a galvanometer needle, or, lastly, by an adaptation of the simpler mechanism of a wheel barometer. We understand that the invention has been patented by Mr. Ansell, and, inasmuch as it gives great promise of successful employment, the apparatus must be deemed well worthy of immediate trial.

Useful Plants.—According to a German author, the number of useful plants has risen to about 12,000, but it must be remembered that these researches have been completed only in certain parts of the earth. There are no less than 2500 known economic plants, among which are reckoned 1100 edible fruits, berries, and seeds; 50 cereals; 40 uncultivated edible graminaceous seeds; 23 of other families; 260 comestible rhizomes, roots, and tubers; 37 onions; 420 vegetables and salads; 40 palms; 32 varieties of arrowroot; 31 sugars; 40 saleps. Vinous drinks are obtained from 200 plants; aromatics, from 266. There are 50 substitutes for coffee; 129 for tea. Tannin is present in 140 plants; caoutchouc, in 96; gutta-percha, in 7; resin and balsamic gums, in 389; wax, in 10; grease and essential oils, in 330. 88 plants contain potash, soda, and iodine; 650 contain dyes; 47, soap; 250, fibres which serve for weaving; 44, for paper making; 48 give materials for roofing; 100 are employed for hurdles and copses. In building, 740 are used; and there are 615 known poisonous plants. According to Endlicher, out of the 278 known natural families, 18 only seem up to the present time to be perfectly useless.—*Cosmos.* i. 283.

Oyster Liquor.—The liquor of oysters is not simply sea water, than which it contains less salt and more organic matter. When shaken with ether, it deposits some albuminous matter containing 8·75 per cent. of nitrogen. The liquor probably plays some part in the nourishment of the oyster, the weight of which is always nearly equal to that of the liquor. The following is the composition of the liquor:—

Water	95·888
Salts	3·022
Nitrogenised matters. . .	0·560
Non-nitrogenised matters . .	0·529

Subjoined are the relative weights of shells, flesh, and liquor in a dozen oysters weighing 1482 grammes:—

Shells	1·209
Flesh	112
Liquor	102

By converting the nitrogen of the oyster into nutritive matter, M. Payen calculates that a dozen oysters represents in nitrogenised matter only the tenth of a man's ration.

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the Editor and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. *Private* letters for the Editor must be so marked.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. X. of the Chemical News, containing a copious Index, is now ready, price 11s. 0d., by post, 11s. 6d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. XI. commenced on January 6, 1865, and will be complete in 26 numbers.

Dr. Lyon Playfair.—Received with thanks.

J. J.—The phenomena noticed have received much more simple and satisfactory explanations.

B.—You will find the paper in our seventh volume.

Constant Subscriber.—Consult Ure's "Dictionary of Arts and Manufactures," or Watts and Richardson's "Technology." There are no separate works on the subjects of repute.

Book Received.—"The Simplicity of the Creation," by W. Adolph.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Researches on Yttria,[*] *by M.* O. Popp.

The object of the author's researches was to find a process for separating yttria from terbia and erbia. From the results of his experiments he concludes that the two latter bases have no existence.

By employing the different methods indicated by Mosander—namely, the fractional precipitation of solutions of yttria by ammonia, the fractional treatment of oxalate of yttria by acids, the partial precipitation of an acid solution of yttria by oxalate of potash, he always obtained oxides of which the first portions were of a dark yellow colour after calcination, and the rest of a lighter tint. The first represent the erbia, and the second the terbia of Mosander. The latter portions, pure yttria, according to Mosander, always containing alkalies, lime, and basic salts, should be purified by precipitation with ammonia free from carbonic acid. In its pure state yttria is never white, but has a slightly yellowish tinge, and its sulphate is not efflorescent. As for terbia, it is by fresh fractional precipitations easily divided into the most coloured portion erbia, and the least coloured portion yttria.

Berlin[†] has, moreover, arrived at the same conclusion, and terbium must consequently be expunged from the list of simple bodies.

The comparative study of erbia and oxides of cerium has shown that erbia is confounded with these oxides.

It furnished the yellow precipitate of ceroso-ceric oxide when its solutions were treated by potash and chlorine, and with the spectroscope it also gave the lines characteristic of didymium.

The imperfection of the method of separation by sulphate of potash accounts for the presence of oxides of cerium in yttria. Double sulphates of cerium and didymium are not perfectly insoluble, the degree of solubility depending on circumstances of temperature, concentration, &c.

The author believes he has found a better method of purifying yttria by first transforming oxide of cerium into sesquioxide, then treating the solution by carbonate of baryta, which does not precipitate yttria, but only the peroxides of cerium and didymium.

Yttria thus separated and newly precipitated constitutes a mass resembling hydrate of alumina; it is pure white, and its taking a rose tint when dried proves that it contains cerium. When calcined it has a yellowish-white tinge. The hydrate contains nearly YO_2HO.

Yttria is an energetic base which expels ammonia from ammoniacal salts on boiling; its properties much resemble those of magnesia.

Hydrated salts of yttria have all a decided rose colour. Solutions of yttria, placed between the prism of the spectroscope and a bright gas flame, give five black lines quite different from those of didymium. Of these rays one is situated in the extreme violet, and one in the extreme red.

The author determined the atomic weight of yttria by the sulphate, which is separated on boiling the solution of sulphate of yttria. This sulphate was precipitated by oxalic acid, the free acid neutralised by ammonia, and finally the oxalate was calcined. Four determinations having varied from 42·04 to 42·008, the mean for yttria was the equivalent 42·015, or in round numbers 42; for yttrium say 54, admitting the formula YO for yttria.

Yttrium.—This metal is obtained by treating the double chloride of ammonium and yttrium. It forms a black powder, becoming lighter by drying, and oxidising slightly in the air. When dry it ceases to oxidise. Water acts on it very slowly when cold, and more rapidly when hot, transforming it into oxide. Diluted acids dissolve it readily with disengagement of hydrogen. When cold, caustic potash does not attack it, and it does so with difficulty when hot.

On platinum foil it burns brightly.

Sulphide of Yttrium.—The sulphide cannot be obtained in a state approaching purity except by passing a current of dry hydrogen and sulphide of carbon over yttria heated to redness; even then it contains a little carbonate.

It is of a yellowish-green colour, insoluble in water, but by contact with it is partially transformed into hydrate of yttria and sulphuretted hydrogen.

Chloride of Yttrium, dried in a water bath, and crystallised in alcohol, contains $YCl+6HO$. It is deliquescent. The anhydrous chloride cannot be obtained by evaporating the hydrated salt, nor by calcining yttria in a current of chlorine or hydrochloric acid; in each case an oxychloride, $2YOYCl$, insoluble in water, is always obtained.

This anhydrous chloride is obtained by calcining the oxide, mixed with carbon, in a current of chlorine, or by heating the double chloride of ammonium and yttrium until the whole of the ammoniacal salt is volatilised. Chloride of yttrium forms a translucent, very deliquescent, crystallised mass. It is not volatile. It combines with bichloride of mercury, forming the crystallised salt $YCl+2HgCl+6HO$, soluble in alcohol.

The iodide is obtained in a crystallised state by dissolving yttria in hydriodic acid, and evaporating over sulphuric acid. It is deliquescent and soluble in alcohol.

The author besides describes the *fluoride*, the *fluosilicate*, *ferrocyanide* an *yttriopotassic ferrocyanide*,

$$2KCyFeCy+2YCyFeCy;$$

the *sulphate* $2(YOSO_3)+5HO$, which is precipitated in the form of a crystalline powder when its solution is heated; a *sulphate* of yttria and *potash;* the *seleniate*, which is very soluble at all temperatures; the *nitrate*, $YO.NO_5+3HO$; the *carbonate*, $YO.CO_2+3HO$; the *phosphate*, $3YO.PO_5+5HO$; the *arseniate*, *chromate*, *chlorate*, *acetate*, $YO.C_4H_3O_3+2HO$; the *oxalate*,

$$C_4O_6.2YO+6HO;$$

the *yttriopotassic oxalate*, $C_4O_6KO.YO+6HO$; two *citrates*, one tribasic with $7HO$ or $14HO$, the other bibasic, with $8HO$; *tartrates*, $C_8H_4O_{10}.2YO+8HO$ and $C_8H_5O_{11}.YO$; the *butyrate*, which is crystallisable and contains $2HO$, and finally *succinate*, which forms a crystalline powder, insoluble in hydrochlorate of ammonia, soluble in diluted acids, its formula being

$$C_8H_4O_6,2YO+3HO.$$

The Estimation of Alumina by Carminic Acid, and the Action of some Reagents on Carminates,[*] *by M.* C. Luckow.

A solution of cochineal or carminic acid has the property of colouring carmine a liquid containing alumina; when acidulated this liquid turns orange. The author has taken advantage of this reaction to make some analytical researches on alumina. The following are the

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[*] *Annalen der Chemie und Pharmacie*, cxxxi, 179.

[†] Forhandlinger med de Skandinaviske Naturforskeres attende Møde i Kjøbenhavn. 1860.

[*] *Journal fur Praktische Chemie* xc., 399.

results he has obtained. Carbonate of soda precipitates alumina imperfectly; in the presence of an ammoniacal salt the precipitation is more complete; with bicarbonate of soda instead of soda it is almost perfect. The more slowly the cold precipitation by carbonate of ammonia is effected, the more complete it is. The precipitate obtained with bicarbonate is less bulky than that obtained with neutral carbonates, and is consequently more easily washed.

The precipitation of alumina by carbonate of ammonia or ammonia is complete if the liquid is boiled until it returns to its neutral state. The filtered liquid does not give, with carminic acid the reaction characteristic of alumina.

The cold precipitation by ammonia or by sulphide of ammonium is more complete the longer the time taken to effect it, and the smaller the excess of ammonia and the greater the excess of sulphide the better.

By passing a current of carbonic acid into a solution of alkaline alumina, the precipitation of this base is almost perfect.

By boiling an alkaline solution of alumina with chloride of ammonium until the reaction is no longer alkaline, the alumina is completely precipitated.

Alkaline carminates are soluble in water, very little so in alcohol; their solution is of a red violet colour. Alkaline earthy carminates are almost insoluble, the colour of their solution is carmine red.

Carminates are decomposed by acids, giving an orange coloured solution, which does not alter on boiling. The solution of carminate of alumina, such as is obtained by the addition of tincture of cochineal to a neutral solution of alumina, free from iron, has a beautiful carmine colour, which turns to violet by contact with the air, especially when hot; if the solution be acid, this change does not take place; when the free acid is tartaric or citric acid, a red pulverulent deposit, formed probably of carminate of alumina, is, after a short time, obtained; this deposit is very little soluble in water, insoluble in alcohol, but soluble in acids and in alkalies.

Carminates of iron form precipitates of a dark violet (ferrous salts), or brown (ferric salts), slightly soluble in water; strong acids, and also concentrated alkalies decompose them.

Carminates of zinc, nickel, cobalt, and manganese are almost insoluble; their colour is carmine violet.

Salts of lead and copper are insoluble, and dark violet in colour.

By adding a solution of cochineal to a stannous salt, a violet colour is obtained, becoming dark carmine if the solution is shaken in the air, or, better still, with chlorine water.

Carminate of silver is unstable.

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

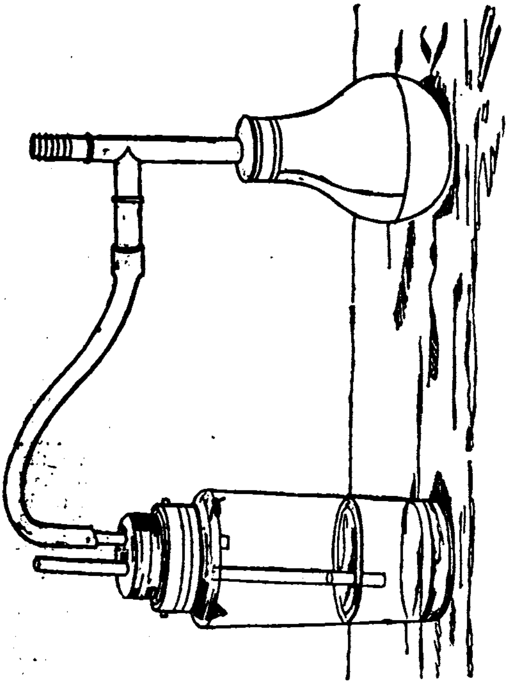
April 4th, 1865.

(*Continued from page 200.*)

Mr. Dancer also read a paper "*On Pseudoscopic Vision through Prisms.*" If we look with both eyes at an object, such as the flat top of a table, for example, and then interpose a prism between one eye and the object, we discover, after a short time, that the portion of the surface to which the sight is particularly directed has apparently changed its distance. If, in trying the experiment, the thin edge of the prism is turned inwards to the nose, the flat surface will appear concave; if, on the contrary, the base or thick edge is turned towards the nose, the surface will appear convex. The full effect of this alteration in the appearance of the object is not realised immediately, some persons see it perfectly in a few seconds, others require some moments of steady gazing before it becomes evident to them. The character of the surface to which the vision is directed exercises some influence in producing the effect. A circular table covered with a cloth of a bright pattern, having a few articles disposed towards the edges, exhibits this fallacious vision in a marked degree. The angle of the prisms for showing these experiments should be about 15°; if less than this, the elevation or depression of surface is not sufficient to produce a good effect; if the angle is much greater than 15°, many persons are unable to unite the refracted image of the prism with the real image seen by the other eye. Achromatic prisms are much to be preferred in these experiments to those which are uncorrected for colour. Experiments with these prisms have shown that the power of converging the optic axes differs very considerably in individuals. Oculists occasionally recommend prismatic lenses mounted in spectacles to assist persons who suffer from insufficiency of the recti interni muscles; it would be interesting to know if those so assisted have noticed the fallacious appearances which the healthy eye can appreciate. The pseudoscopic effects are exaggerated by using a prism to each eye, but in most persons this produces a painful sensation. The explanation of these phenomena, which I offer with some hesitation, is based upon the supposition that in binocular vision we estimate the distance of an object by the degree of convergence of the optic axes. In these experiments, when a flat surface appears concave by the interposition of the prism: the optic axes are made to converge on a point situated behind the real surface, and the imagination gradually removes the object to this apparent distance. When the base of the prism is towards the nose, then the flat surface becomes convex, in this case the optic axes cross in front of the real surface, and the imagination raises the object to that point. A diagram of the convergence of the optic axes on an object, before and after the interposition of the prism, will show that when the thin edge of the prism is turned towards the nose, the effort made to unite the real and the refracted image is the same as if the vision was directed to a point more distant than the real object. The opposite to this takes place when the base of the prism is turned towards the nose. It is very possible that the pseudoscopic vision through prisms may have been noticed by others, but I have not been able to discover any description of such in the works to which I have access.

Dr. Angus Smith explained a mode of analysis which he has called *Minimetric.* The idea, he said, may perhaps not be quite new, but it is well to give the method a name. It is based mainly on the fact that we can retain in the memory with great exactness the character of a precipitate of a given degree of translucency. For carbonic acid the author finds a precipitate of carbonate of baryta caused in baryta by ·2515 cub. c. of carbonic acid, or nearly three times that amount in lime water. If the carbonic acid in air is sought, the air is made to act on the baryta until the precipitate is obtained. If the carbonic acid in air is sought, the air is made to act on the baryta until the precipitate is obtained. In other words, we use the smallest measure of air which will produce the precipitate. For this reason the name minimetric is adopted. The plan may be used for hydrochloric acid, sulphuric and sulphurous acid, sulphuretted hydrogen, &c., and probably has been used frequently without bringing it forward as a method for accurate use. Two modes of using this mode of analysis were described. The first was by the use of a finger pump—an elastic ball with two valves. When pressed the air was driven out, and when expanding the air was drawn through the liquid. The air and liquid were then shaken together. This was repeated until the precipitate was attained. One easy method of finding the precipitate for comparison was by shaking half an ounce of avoirdupois (14·17 cub. c.) with twenty-three ounces of air in Manchester, or nearly thirty in London or elsewhere, according to residence. Experiments made with this apparatus show it to be extremely delicate. The carbonic acid in the air of a room can be estimated in a few minutes.

A table is made of the following kind, but it must be adapted to the size of the bulb. A cut showing the bottle and finger pump is given.



For very bad air smaller bulbs were shown, such as were recommended for workshops, mines, &c.; a convenient size for common life is here given:—

No. of strokes of the finger pump, or No. of ballfulls of air.	Per cent. of carbonic acid indicated in the air.	Actual amount of carbonic acid in the Air of the ball. Grammes
1	6·0	0·2515
2	3·0	0·1257
3	2·0	0·0838
4	1·5	0·0629
5	1·2	0·0503
6	1·0	0·0419
7	0·8	0·0359
8	0·75	0·0316
9	0·66	0·0279
10	0·056	0·0251
11	0·054	0·0229
12	0·0499	0·0209
13	0·0460	0·0193
14	0·0428	0·0180
15	0·0399	0·0167

In all cases only half an ounce of baryta solution was used.

Minimetric House and Workshop Method.

Suppose we desire to know if the air contains more than 0·04 per cent. of carbonic acid, we fill a bottle containing 5·422 ounces with air by pumping as elsewhere described, with a little finger pump, and shake in it half an ounce of baryta water. If there is any precipitate at all, the amount of carbonic acid in the air is above 0·04 per cent. This would indicate that the air is less pure than outside. If we allow 0·06 per cent. of carbonic acid in a room, we take a bottle of the size of 3·6 + ½ ounce = 4·1 ounces, or 116·23 c.c., and if, after a trial as before, we find a precipitate, however small, or a decided, although slight, milkiness, the air is deteriorated beyond 0·06. This relates to dwelling-houses. If for workships ¼ per cent. (0·25) is allowed, a bottle of 0·867 + 0·5 ounce = 1·367 ounces or 38·744 c.c. is sufficient. This would go into the waistcoat pocket. If 0·5 or ½ per cent is permitted, a bottle of 0·433 + 0·5 ounce is enough = 0·933 ounces or 26·475 c·c. This amounts to nothing more than shaking an ounce bottle. The addition of half an ounce is for the baryta water. The lime-water method will probably be adopted more usually, as lime is so common. The experiment is exactly the same as with baryta water, but larger bottles are required.

0·06 carbonic acid in the air gives no precipitate or milkiness when ½ ounce of lime-water is added to a bottle of the air, containing . . . . . 10·9 ounce.
(= 309 cub. cent)
0·25 ditto ditto 2·997 ounces.
(= 84·958 cub. c.)
0·5 ditto ditto 1·748 ounces.
(= 49·564 cub. c.)

The author said that by this simple method the greatest refinement could be attained.

ACADEMY OF SCIENCES.

April 24, 1865.

M. **Debray** presented a memoir "*On the Chlorides of Tungsten.*" The primary object of the author's experiments was to determine the vapour densities of these chlorides. To prepare the perchlorido he passed a current of dry chlorine over tungsten heated to dull redness. but found that the body obtained in this way is a mixture of perchloride WCl_3, and subchloride W_2Cl_3. To procure the perchloride as pure as possible it is necessary to re-distil this mixture in a current of chlorine; but even then an absolutely pure perchloride is not obtained, for it is another example of a body which, like monohydrated sulphuric acid, decomposes at its boiling point, giving a product of a tolerably constant composition under similar conditions, but which cannot be expressed by a simple formula. There are two oxychlorides of tungsten, one red, $WOCl_2$, and the other yellowish-white, WO_2Cl. They are easily obtained by distilling the perchloride with oxalic acid in proper quantities. The author could not determine the vapour densities of the yellow oxychloride because of its ready decomposibility. He determined, however, the densities of the two other chlorides in the vapour of mercury and in the vapour of sulphur, and found them not to agree with either the theoretical density of two or four volumes. He is led, in fact, to the supposition that the red oxychloride has the formula—

$$W'_3O_5Cl_{10} \text{ or } W'O_5 + 2W'Cl_5,$$

which obliges him to admit the existence of bodies whose vapour densities correspond to 12 volumes. The author attempted no explanation of this difficulty, nor did M. Deville, who said a few words on the importance of these experiments.

Dr. Blondlot presented a memoir "*On Black Phosphorus.*" The author shows how phosphorus can be converted into the black variety at will. He distils phosphorus which has been exposed to the sun, and collects it in a flask which is slowly cooled in a water bath; and he finds that it becomes a white mass at about 44°, but at 5° or 6° it suddenly turns to a beautiful black colour. Once obtained this black phosphorus can be re-distilled and fused; it is colourless while liquid, but again becomes black on cooling. The author seems to regard black as the proper colour of phosphorus.

M. Violette presented a note entitled "*Researches on the Cause of the Crystallisation of Supersaturated Solutions*," and M. Gernez a note "*On the Crystallisation of Supersaturated Saline Solutions*," and "*on the Presence of Sulphate of Soda in the Air*." Both of these notes relate to the circumstances attending the crystallisation of a supersaturated solution of sulphate of soda, and the two authors have come to the same conclusion on one important point—namely, that there is but one body capable of bringing about the sudden crystallisation which takes place with such a solution, and that is, a fragment, no matter how minute, of the same salt. The two authors imagine they have discovered a new method of analysis when they have found that to induce crystallisation of supersaturated solution a fragment of the dissolved salt is necessary.

M. Persoz continued his memoir "*On the Molecular Condition of Bodies*;" but this section requires no notice.

Dr. Frankland and M. Duppa communicated some "*Synthetical Researches on Ethers*," which we shall no doubt see in the *Proceedings* of the Royal Society; so pass them here.

MM. Millon and Commaille presented another note "*On the Caseine of Milk and its Affinities*." In a previous note the authors announced that caseine combined with acids in definite proportions; they now show that these acid compounds function as chemical units, like caseine itself. Sulphuric and phosphoric acid the authors state may be united simultaneously with caseine; and they remark that this fact will strike those who know how common it is to find both sulphur and phosphorus in albumenised matters. The compounds of caseine with acetic, hydriodic, perchloric, and hydrosulphocyanic acid are all decomposed by water, and from the acetic compound pure caseine may be separated. The authors have analysed this, and state its composition to be

$$C_{108}H_{97}N_{14}O_{29}+5HO;$$

that is, a double amide of tyrosine and leucine. This, by the way, is soluble caseine; the insoluble has only three equivalents of water.

M. Blondeau presented a note "*On Goëmine*," a neutral body extracted from *Fucus crispus*, or Carrageen moss. The jelly obtained from this seaweed is, of course, not formed of ordinary gelatine, but by a neutral body soluble in hydrochloric and nitric acids, and in potash. Its centismal analysis is as follows:—

Carbon	21·80
Hydrogen	4·87
Nitrogen	21·36
Sulphur	2·51
Oxygen	49·46
	100·00

The abundance of nitrogen in the compound shows it to be a valuable nutriment.

NOTICES OF BOOKS.

The Applications of Geology to the Arts and Manufactures. Being Six Lectures on Practical Geology, delivered before the Society of Arts, as a part of the "Cantor" Series of Lectures for 1865. By Professor D. T. Ansted, M.A., F.R.S., &c., &c. London: Hardwicke. 1865.

We are bound to praise the mode in which the money bequeathed to the Society of Arts by the late Dr. Cantor has been employed, and more particularly the selection of the lecturers. Although these latter have addressed a too exclusive audience, one of them has, and will shortly again, we hope, find a much more extensive one in our own pages, which will thus convey to thousands the useful and varied information that was listened to by a few only.

Of these lectures by Professor Ansted, we can speak in very high terms. No one is better qualified than he to speak of what we may call the raw materials of the earth's crust. It is only when dealing with manufacturing processes that the learned Professor goes a little astray,—witness the chapter on Cements and Plasters; but as no one will think of reading his book as a guide to manufactures, we may pass these slight blemishes by as of small account.

The lectures are six in number, and are devoted respectively to agricultural geology, springs and water supply, minerals obtained from superficial deposits, minerals from stratified deposits (two), and minerals obtained from mineral veins and mining. This programme will give our readers the best idea of the contents of the book, and for the rest we need only say that they will be read with as much pleasure as profit.

We have marked several passages for quotation, but have only room for one on the formation of vegetable soil, which will give our readers a good idea of the Professor's style.

"Every kind of vegetable soil was once rock, which, by the unintermitting action of heat and cold, air and water, has been broken down by degrees into smaller and smaller fragments, until at last it is reduced to a kind of powder, dust, or mud.

"The part of this process performed by the atmosphere is called *weathering*. It goes on constantly—day and night, winter and summer; in a wet or dry, in a calm or stormy atmosphere. It breaks down the hardest rocks on the lofty mountain tops, as well as removes the soft mud on the plain. It eats away the bottom of the deep-sheltered valley, and pares away the surface of the barren exposed moor. It affects the toughest granite and the softest clay or loosest sand. Wherever rock is exposed to the air it becomes weathered, and weathering means ultimately a reduction to fine powder.

"On the granite or quartz rock exposed on the cliff or in the quarry a group of small lichens is seen to grow. These only seem to ask from the rock a solid foundation; but they are insidious enemies, as, although they derive their nourishment chiefly from the atmosphere, and might be thought even to protect the exposed naked surface from the weather, they really pave the way for destruction. That which they separate from the air and employ in the construction of their lengthening bodies becomes after their death a brown pulverulent mass, or *humus*, which affords nourishment to larger individuals of the same tribe. At length there is sufficient of this humus or vegetable soil to support a higher class of vegetation. Various mosses succeed the lichens. These take root, and small crevices, such as are formed by exposure on the surface of all rocks, receive their roots. Once inserted, these roots expand and exercise an irresistible force, splitting asunder the rock and breaking up the surface. Other roots are thus enabled to penetrate yet further, and after a time the first mosses are succeeded by more vigorous branching kinds, and these again, according as the climate is dry or moist, are followed by heather, ferns, grasses, or small shrubs, until at length, each generation of plants working its way deeper into the rock and increasing the quantity of soil, there is attained a sufficiently deep thickness of earth to enable forest trees to grow, thrusting down their rootlets to a great depth in the crevices, and making room for the admission of rain. In due time frost comes, rending asunder the rock, and producing in hilly countries or near cliffs frequent slips and slides, falling into the valleys below, but soon spread over the surface and lost sight of, being washed away by the rain."

We have extracted this passage from the lecture on Agricultural Geology, which is particularly good; but the reader will peruse the whole book with equal interest.

Annales de Chemie et de Physique. March, 1865.

This number of the *Annales* contains the conclusion of M. Gaugain's memoir on the theory of electric condensers, and an interesting historical notice of the mechanical theory of heat, by M. Bohn. An account of some experiments by Payen, "*On the Action of Diastase on Amylaceous Substances*," is of some interest, inasmuch as they disprove some assertions of Musculus (see Chemical News, vol. ii., p. 299). The latter gentleman has stated that diastase is without action on dextrine; that diastase in reacting on starch produced dextrine and glucose simultaneously in the proportion of one of glucose and two of dextrine; and hence, in the manufacture of alcohol from grain; there was a waste of two-thirds of the raw material. Payen now proves that diastase can, in part, transform dextrine into glucose; the progress of the action is hindered by the presence of glucose, but is resumed when this glucose is removed; that in the alcoholic fermentation nearly the whole of the amylaceous matter is transformed into alcohol, &c.; that diastase reacting on starch under favourable circumstances converts about half into glucose. These experiments being of some practical importance, we shall give the account of them at length.

A very interesting paper by M. Morren follows "*On the Phosphorescence of Rarefied Gas during the Passage of the Electric Spark.*" The author endeavoured to discover the cause of the milky-white fog seen in some of Geissler's tribes. It has been attributed by many to the presence of oxygen; but this idea M. Morren shows is incorrect. He finds, in fact, that pure and dry oxygen, however much rarefied, is never phosphorscent; and indeed that no gas, simple or compound, is phosphorescent by itself. A mixture of oxygen and nitrogen with 37 of nitrogen to 100 of oxygen is feebly phosphorescent; but the phenomenon becomes much more visible when a little vapour of nitric acid is added to the mixture. But it becomes magnificent and lasting when to the preceding mixture a drop of Nordhausen acid or a little vapour of sulphuric acid is added. The same result may be obtained by passing the spark through a rarefied mixture of the following gases:—

Oxygen	500
Nitrogen	200
Sulphurous acid	300
Or,	
Very dry atmospheric air	100
Oxygen	30

and a little Nordhausen or anhydrous sulphuric acid. Other acids besides sulphuric will produce similar results—nitric and carbonic, for example; and the author shows the probability of being able to combine these gases with NO_2. He states that it is possible to form directly the compound $NO_{3}2SO_{3}$ by the spark in convenient apparatus.

A paper, by the same author, "*On the Flame of Some Carburetted Gases, particularly Acetylene and Cyanogen*," succeeds. We have already noticed this paper (Chemical News, vol. ix., p. 135) in connection with the spectrum of carbon, and the theory of the candle flame. The same author gives an account of *a new air-pump*, or rather *mercurial aspirator*, invented by himself, which is said to be extremely convenient for exhausting limited spaces. A description of this machine would be useless without a drawing, so we refer the reader anxious in the matter to this journal, in which a good drawing is given.

The next paper is also by M. Morren—"*On the Electric Conductibility of Gases at Low Pressures*,"—at the close of which he describes some beautiful phenomena obtained with cyanogen, and mentions the deposition from this gas at the positive electrode of a reddish-brown substance, which is soluble in *aqua regia*, and which solution, on the addition of distilled water, gives a yellow gelatinous precipitate.

The report made to the Academy "*On the Experiments Relative to Spontaneous Generation*," which follows, we have already noticed, and also the concluding paper—on M. Weil's "*New Process for Coating one Metal with a Brilliant Layer of another Metal.*" As, however, the process is more fully described here than in any account of it we have met with before, and as it is of some practical importance, we shall return to it again.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

240. C. D. Bergue, Strand, "Improvements in furnaces."—Petition recorded Jan. 27, 1865.

705. F. Wise, Chandos Chambers, Adelphi, "Improvements in preparing certain colouring matters for dyeing and printing." A communication from J. Levinstein, Berlin, Prussia.—March 13, 1865.

980. G. Davies, Serle Street, Lincoln's Inn, Middlesex, "Improvements in the means of, and apparatus for, increasing the illuminating power of hydrocarbon oils and gases." A communication from T. S. Speakman, Camden, New Jersey, U.S.A.

984. W. B. Richards, New York, U.S.A., "An improved mode of preventing corrosion or staining of the surface of glass."—April 6, 1865.

997. W. Jackson, Glasgow, N.B., "Improvements in the method of mixing gases and vapours, and in the machinery or apparatus connected therewith."—April 7, 1865.

1008. G. Davies, Serle Street, Lincoln's Inn, Middlesex, "An improved composition for preventing the fouling of ships and other vessels." A communication from W. B. Davies, Brooklyn, King's County, New York, U.S.A.—April 8, 1865.

1023. C. Vaughan, Birmingham, "Improvements in the manufacture of iron and steel."

1027. R. A. Brooman, Fleet Street, London, "Improvements in apparatus for storing petroleum and other inflammable liquids of less specific gravity than water." A communication from F. Bizard and P. Labarre, Marseilles, France.—April 11, 1865.

1049. J. S. Bickford, Camborne, Cornwall, "The manufacture of an improved safety fuze."—April 12, 1865.

Notices to Proceed.

3071. J. Vaughan, Middlesbro', Yorkshire, "Improvements in the heating the blast for furnaces in the manufacture of iron."—Petition recorded December 10, 1864.

3075. E. Brooke, Huddersfield, Yorkshire, "Improvement in the manufacture of glass house pots."—December 12, 1864.

3082. R. H. Johnson, Eccleston, Lancashire, "Improvements in the construction of glassmakers' pots and in the application of heat to the materials or glass metal contained therein."—December 13, 1864.

3108. J. A. Pols, Old Kent-road, Surrey, "Improvements in obtaining purified or refined oils, and in obtaining oil cakes for cattle food, and foots for soap-making."—December 15, 1864.

3131. A. A. L. P. Cochrane, Portsmouth, Hampshire, "Improvements in apparatus for heating and evaporating liquids and fluids."—December 17, 1864.

3164. H. A. de Brion, Welbeck Street, Cavendish Square, Middlesex, "An improved varnish for protecting and preserving metals, such as polished steel, silver plate, silver-plated and electro-plated articles from oxydation, corrosion, and from the effects of damp, or the action of sulphuretted hydrogen and improved liquids for cleaning and brightening said articles."—December 21, 1864.

3252. L. P. E. Max, Paris, "Improvements in treating oils and hydrocarbons, and in apparatus for the same, and other operations in which matters have to be purified, clarified, and refrigerated or condensed."—A communication from E. Laporte, Boulevart de Sebastopol, Paris.—Dec. 30, 1864.

160. M. B. Mason, New York, U.S.A., "An improved method of purifying and oxidising metallic ores."—Jan. 19, 1865.

344. W. Sim, Glasgow, N.B., "An improved method of, and improvements in apparatus for extracting gases from mineral oils, and employing the same for illuminating purposes."—Feb. 7, 1865.

402. L. H. G. Ehrhardt, Richmond Road, Bayswater, "An improved gunpowder."—Feb. 15, 1865.

645. A. C. Henderson, Charing Cross, Middlesex, "An improved method of preserving meat."—A communication from H. F. Méressart, Paris, France.—March 8, 1865.

691. J. Henderson, New York, "Improvements in the process and apparatus for refrigerating or freezing liquids."—March 11, 1865.

CORRESPONDENCE.

Continental Science.

Paris, May 2.

The delegates from the learned societies of France held their sittings at the Sorbonne last week. Many very interesting papers were read at these meetings, most of which, however, have already been communicated to the Academy, and I see that you have noticed them in your pages. But there were some original communications made, of which I shall hope to furnish you with some account. It is thought, however, that the proceedings were of less interest than usual, and the attendance was smaller.

Some public experiments have recently been made with Galibert's apparatus, which I mentioned some time ago. A fireman, furnished with the apparatus, went into a room filled with sulphurous acid, and remained there twelve minutes without experiencing any discomfort. M. L'Abbe Moigno also exhibited, and made a trial of, the apparatus at his last monthly meeting with full success. It would be well if this invention were introduced to the notice of the London scientific public, as it seems to afford perfect safety in the most vitiated atmosphere.

A method of preserving ice is going the round of the papers here, which I send you, as it is often required to keep some as long as possible when people are not provided with an ice-safe. Put the ice on a dish and cover it with a napkin, then set the dish upon a feather bed or pillow, and place another bed or pillow on the top of it. In this way you may keep a few pounds of ice for a week or more.

I may mention here the existence of a society such as probably some would like to have in London. It is a society of naturalists, who meet every Sunday from May to August, and make short excursions in the environs of Paris to collect botanical, entomological, geological, and palæontological specimens. They made their first excursion last Sunday in the Forest of Montmorency.

Two gentlemen, MM. Sicard and Schoras, have chemically examined some poisonous mushrooms, and have succeeded in extracting an extremely poisonous substance, which appears to have basic chemical properties. The physiological effects seem to resemble those of curarine. I have not yet seen the process by which this poison is isolated.

Your surgical readers will, no doubt, see with much interest an account of an operation by M. Ollier, well known in England by his experiments on the reproduction of bone from the periosteum. That which M. Ollier has often shown to be possible in the case of animals, he has now shown to take place in the human subject. He removed the upper half of the humerus from a child, six years old, for disease of the shoulder-joint, carefully detaching the periosteum all round, and dividing none of the muscular attachments. The child now, seven months after the operation, is in good health, and the arm is almost perfectly restored.

M. Seguier, who claims to have first suggested the combined use of gun-cotton and coarse-grained gunpowder, which Mr. Whitworth has latterly adopted, has sent to the Academy an account of a cartridge he has invented, which he considers to have many recommendations. He puts into a metallic case a certain amount of gun-cotton, and on this he places a perforated wad. Upon this wad he puts the coarse-grained powder, and now the projectile, which rests upon the powder. By a peculiar contrivance, something like that of the Prussian needle gun, the powder is first ignited, and then the gun-cotton. The author states that the best application of the force developed by the conversion of solid into gaseous matter is to generate this force *crescendo*, as the musicians say, first overcoming the *inertia* of the projectile, and then giving its greatest velocity. The velocity obtained with these cartridges seems to be prodigious; but one thing will greatly recommend them—there is said to be no recoil of the gun when they are employed. I ought to have told you that the author uses spun, not carded cotton.

MISCELLANEOUS.

FAREWELL DINNER TO DR. HOFMANN.

On the evening of the 28th ult., at the Albion Tavern, Aldersgate Street, a number of gentlemen who have worked with Dr. Hofmann at the Royal College of Chemistry at different periods from its opening in 1845 to the present date, entertained the Professor at a farewell dinner immediately before his departure for Berlin.

The chair was occupied by Dr. Warren De La Rue, F.R.A.S., F.R.S. The following is a list of those who took part in the entertainment:—Their Royal Highnesses the Comte de Paris, the Duc de Chartres, and the Prince de Condé; Messrs. F. A. Abel, F.R.S., A. H. Church, M.A., W. Crookes, F.R.S., G. B. Buckton, F.R.S., F. Field, F.R.S., W. Odling, M.D., F.R.S., E. C. Nicholson, J. Kayess, B. Condy, G. Maule, A. P. Price, Ph.D., W. Valentin, W. H. Perkin, G. de Mussy, M.D., R. M. Hands, H. Müller, Ph.D., M. Holzmann, Ph.D., W. Squire, Ph.D., S. Heywood, M. Garcia, J. S. Brazier, — Böttinger, Ph.D., P. Griess, B. Duppa, H. Basset, W. Scott, — Barret, Ph.D., E. Owen, H. Medlock, Ph.D., T. Bealey, W. T. Dent, J. Spiller, E. O. Brown, R. E. Alison, J. A. Spencer, C. Berger, J. Newlands, E. Southby, W. Wilson, J. Matthews, E. J. Chapman, P. Chabot, M.A., A. Vacher, R. Barton, J. B. Barnes, W. Spiller, B. Cooper, G. F. Ansell, A. Murgatroyd, W. J. Belton, C. O'Sullivan, G. Davis, G. F. Pritchard, W. T. Fewtrell, F. A. Potter, H. T. Lowe, J. Romanes, F. A. Manning, J. Davidson, W. J. Barnes, H. Tomlinson, J. Williams, W. J. Roberts, J. P. Wilson, T. Royle, L. Heseltine, &c.

During the dinner, which was on a magnificent scale, an excellent selection of music, both instrumental and vocal, was performed by the band of the Royal Artillery, under the direction of the talented bandmaster, Mr. Smyth.

After the usual loyal toasts, the Chairman called upon the honorary secretary, Mr. Field, for his Report.

Mr. Field rose and said: In presenting you, Mr. Chairman, with a brief report of the duties which have devolved upon me as Secretary to the "Farewell Dinner to Dr. Hofmann," I have great satisfaction in stating that from all quarters, not merely in our immediate neighbourhood but from far distant localities—from the most distinguished chemists of our country to the youngest student just stepping upon the threshold of chemistry—from the lowliest amongst us to the scions of the royal and illustrious house who have honoured us this evening with their presence, there has been a concurrence of sympathy and spontaneity of acquiescence in our proposed arrangements which have rendered the task of secretaryship not only easy, but delightful. I have issued more than two hundred and fifty letters of invitation to gentlemen who have studied under Dr. Hofmann in the College of Chemistry, from its commencement to the present date, a period extending over nearly twenty years. Many students have doubtlessly and unavoidably been omitted, for although it was not difficult to arrive at the names of those gentlemen, it was not so easy to discover their places of abode. Chemists move often in an eccentric orbit, and at times are somewhat erratic in their movements. There are many, at this present moment, in distant parts of the globe, disseminating, let us hope, the light of their knowledge to others less fortunate than themselves. With such, it was impossible to communicate in time, even had it been possible for them to attend. Many also during their stay at the College had merely temporary resting-places in London, and had left no trace behind. But we have been fortunate altogether in our research; and in the reluctant refusals which distance and want of opportunity have rendered imperative, there is a prevailing characteristic throughout of regret and disappointment at the impossibility of meeting us this evening. It would be in vain for me, without trenching too much on your valuable time, to read all the correspondence which has been received, or even to afford you a list of the correspondents. You will allow me, however, to select a few names, more conspicuous, perhaps, than others, that I have noticed in the multifarious communications which I have received. Dr. Rowney would have had the greatest pleasure in attending, had not the distance from London and his occupations in the College at Galway prevented him from doing so. Dr. Rowney, Mr. Chairman, will be well remembered by you and the earlier students as an amiable colleague and genial friend, and by those who are not personally acquainted with him as a most accurate and conscientious analyst. M. Kuhlmann, of Lille, also begged me to acquaint the committee how much his heart was with us, and he insisted on sending his subscription. Dr. Muspratt, of Liverpool, regrets that his departure for the Continent will not allow him the satisfaction of meeting with ourselves his early friend and collaborateur, Dr. Hofmann. Captain Hore especially regrets that his engagements at Paris prevent him joining us to-night. Dr. Geiger and Mr. McLeod, two of Mr. Hofmann's present assistants, have already left for Berlin. Colonel Reynolds, an old and distinguished collegian, is extremely disappointed that a sudden journey to France has deprived him of the delight he should experience in joining us round the festive board. Dr. Galloway writes in the same spirit, wishing for his own sake that our meeting had been in Dublin instead of in London, and I regret to say that I have only this moment received a note from Mr. Sieveking, informing me that domestic indisposition unwillingly keeps him away. And so, Mr. Chairman, might I go on mentioning many more of our old friends, and it almost seems invidious, and it is certainly difficult to select one correspondent from another, when all write the same sentiments and every refusal is tempered with an equal regret. I have three communications to make from among the absentees in our Committee. Mr. George Simpson (one of its earliest members) is compelled to forego the pleasure he had anticipated, as a recent and severe domestic affliction has rendered his presence impossible. Dr. D. S. Price has an important engagement in another part of England, and Mr. Edward Thomas has recently left for France. Among the guests whom the Committee have done themselves the honour to invite, I have to mention two names especially interesting to us. The Master of the Mint, Mr. Graham, one of the oldest friends of Dr. Hofmann in this country, delayed answering the letter of invitation for some days, trusting that a severe and troublesome cough from which he was suffering would disappear, and allow him to meet us to-night. Such, unhappily, has not been the case, and he had finally to send a definite refusal, concluding his letter with these words:—"Although I shall not be with you, believe me, my whole heart is in the success of the entertainment." The other name, Sir Thomas Clark, is one peculiarly endeared to us, for every Royal Collegian owes a debt of gratitude to that distinguished baronet. Many of us are old enough in our college life to recollect the time immediately after the Institution was established. We may remember that when the enthusiasm of its commencement had passed away, a corresponding reaction set in, that many of its earliest supporters dropped off, while others merely looked calmly and passively on; that dissensions of a painful and personal character, on which it is needless here to dwell, sprung up amongst its very originators, and such was the state of affairs that not only was its ultimate success deemed problematical, but its very existence seemed imperilled, and the outside world began to consider that the establishment of a college for abstract science was merely a vain and chimerical dream. Then, as ever, Sir James Clark stood forth—its devoted and fearless champion. From among the most conflicting elements he slowly and surely restored harmony and order. Encouraging the Professor (then a recent inmate in England) by his counsel and advice; stimulating the students by his frequent interest in their labours; attaining, by his great influence, from the highest quarters a patronage and distinction for the College, he was, as he still is, its firm, consistent, and undeviating friend; and it is pleasant, Mr. Chairman, for us to reflect that he still lives, and that, in the full maturity of his years, he regards, with no spark of the arrogance that sometimes accompanies an ambition accomplished, but with a pride and complacency at which it would be difficult to cavil, the signal triumph of his earnest and zealous labours. I will read his letter:—

"A public dinner to Dr. Hofmann by the gentlemen who have had the advantage of listening to his lectures and instructions since his arrival in England is a grateful act on their part, well merited by the Professor, and one which cannot fail to be gratifying to him. It would have afforded me great pleasure to have been present on the occasion, but the state of my health unfortunately compels me to forego the great gratification of joining your social meeting to do honour to my esteemed friend. Circumstances have thrown me into intimate relations with Dr. Hofmann ever since, and even before, his arrival in this country. I formed a high estimate of his character at a very early period of our acquaintance, and our uninterrupted intercourse ever since has more than confirmed my first impressions. The high scientific position which Dr. Hofmann so justly holds among the chemists of Europe, and the character of the institution over which he presides, and which, it may be fairly said, he created, have not been attained without the exercise of great talents and untiring labour; while his teaching and researches have given an impulse to the progress of chemistry in this country for which it owes him a debt of gratitude. The Doctor's absence from England will, I trust, be only temporary, and that, when the great object for which he has been called to Germany is accomplished, we shall have him again amongst us, contributing anew, by his genius and researches, to the further advancement of the science already so much indebted to him. I must beg you to excuse the length which I find my note has assumed. The truth is, that I could not express my sincere regret at being unable to attend your dinner without expressing the high opinion I entertain of Dr. Hofmann's character and merits."

Such is the letter from Sir James Clark, and with it my report is concluded. Valuable in itself as a document, it is especially valuable to us, as containing those sentiments which you, Mr. Chairman, and all of us so fully, so cordially, and so heartily endorse, and gratifying as it is in every sense, and is doubly so in giving us the assurance that the departure of Dr. Hofmann does not betoken a final separation, but a temporary absence,—that he leaves us, in fact, merely for a season to prosecute in another land a new and a glorious crusade. (Loud cheers.)

The Chairman, in proposing the toast of the evening, said:—With mingled emotions I rise to propose to you the next toast, for I am deeply impressed with a desire to do justice to my subject; while, at the same time, I am fully aware of my inability worthily to acquit myself of the task. Literally and metaphorically, my heart is in my mouth, for I have to propose for your acceptance the health of one of my oldest and most loved friends on the eve of his departure. For twenty years I have been acquainted with Dr. Hofmann. I have known him under a variety of circumstances, and it is not assuming too much for me to say that I know his innermost heart; and the more intimately I have become acquainted with his motives of action the more highly have I appreciated his great moral worth. (Cheers.) Twenty years!—years that have passed with me almost as a dream; yet how eventful a period in the progress of chemical science. I look back, and try to fix some of the marks by which to measure out and fully appreciate the continuous current of invaluable discovery inaugurated by the advent in England of Dr. Hofmann, and I recall at once the fact of his introducing me at an early period to one to whom he was much attached. Ani-line, then a very coy personage, would throw around herself a purple veil, and disappear when brought into the presence of such energetic personages as chlorine. (Laughter.) *Aniline* is now a matron, with numerous offspring, whose names I do not pretend to recollect, for names with me are slippery things, and some of them are nearly unpronounceable. But I recollect one on whom we have all gazed with admiration—her beauteous daughter *Rose*. (Laughter.) The mention of the family of aniline at once reminds us of a long series of substantial benefits conferred upon England by Dr. Hofmann's teaching; but I must take you back to the earlier years of his stay amongst us. The promoters of the College of Chemistry, in their zeal and confidence in the support of the public, made such offers to Dr. Hofmann that he was induced to accept the professorship. Some of us know that the ability of the promoters to perform their part of the arrangement fell very far short of their anticipations—the existence of the College being, in fact, in danger—and Dr. Hofmann voluntarily gave up in succession, first a portion of his salary, then his share of the students' fees, and lastly his house. Yet during this trying period he never in the slightest degree relaxed his efforts to establish the reputation of the College. (Cheers.) He not only gave up the money which was his due, but, out of his extreme devotion to the educational objects of the College, abandoned what to a German *savant* is of still greater importance, his original scientific investigations. This, I know, he felt at the time most keenly, for not only was he relinquishing a pursuit productive of the highest and purest pleasures, but he was jeopardising his future if the College should unfortunately fail to establish itself. Happily the College has stood fast, and our friend has built up the temple of his fame on so many bases that it cannot fail to endure so long as chemical literature shall exist. (Laughter and cheers.) While speaking of the early trials of the College I must not to omit to mention the honoured name of one for whom I have the highest reverence: I allude to Sir James Clark, who stood by our College and our friend in every difficulty. Sir James Clark's efforts in promoting science will hardly ever, perhaps, receive proper recognition, for his labours have been so unostentatious that scarcely a record of them is left, except in the memory of his friends. Science and men of science have few such staunch friends as Sir James Clark. Dr. Hofmann has been extremely happy in his choice of assistants, and throughout his long and prolific career has been surrounded by such a staff as it has rarely been the lot of any chemist to attract about him. But so, also, has he shown great judgment in selecting other agents—perhaps I ought to say reagents,—(laughter)—and although it would be invidious to select any of his animate friends, when so many are present, yet I may, without danger of wounding the susceptibilities of his inanimate aids, name iodide of ethyl as a substitution agent, which has done much for the progress of organic research. (Cheers.) We are all aware that many inducements were offered to Dr. Hofmann to direct his thoughts to technological chemistry—for a long time, however, without effect, and that when he did almost reluctantly consent to undertake such work, it was usually prosecuted at that period of the day which is generally devoted to recreation or rest. It gives me great pleasure to call to mind, as also it must do in the case of several around me, the many profitable hours spent with our friend in this extraneous work, which usually commenced about midnight, and terminated only when the small hours had grown sensibly larger. Of Dr. Hofmann's teaching it is hardly necessary for me to speak, except to express in his presence the exalted estimation in which it is held by us all. (Cheers.) His deservedly high reputation as a chemist is not greater than his fame as a teacher. We all know that when he speaks the various bodies of which discourses seem no longer inanimate, so vividly does he pourtray their habits and affections, their dislikes and preferences, the causes and characteristics of their mutual actions and relations. Even the crotchets of the atoms are laid bare—(laughter)—and we learn that if it be desired to hold more than a certain number of them in friendly union with some other body, it is needful first of all to induce the co-operation of auxiliary groups. One prominent feature in Dr. Hofmann's teaching has always been the kind and painstaking encouragement he has invariably bestowed on those of his pupils who have desired to enter on original research—(cheers)—and it is gratifying to notice among those met here to-day to say farewell so many who have distinguished themselves in the various branches of chemistry to which they have devoted their attention. You are aware that Dr. Hofmann has, after much persuasion, assented to propositions made to him by the Prussian Government with the view of inducing him to undertake a most important mission. It is most creditable to that Government that they so fully appreciate Dr. Hofmann's high mental, moral, and social qualities, which so peculiarly fit him for the honourable post to which they invite him. It was at one time thought that this would have to be a final leave-taking; but, fortunately, our Government having at the eleventh hour become aware of Dr. Hofmann's intended departure, and being keenly alive to the loss the country would thus sustain, have declined to release him from all the bonds by which he is bound to us, and so we hope in a few years to ask him to meet us again on his return to our land. (Cheers.) It is our fervent wish that in the meantime he may enjoy continued health and ever-increasing prosperity. We should be sorry if this meeting were to pass away just as a passing tribute of our gratitude, and we desire to record in some formal manner that we are here assembled to wish you farewell, and to express a hope that we may see you here again. (Loud applause.)

The memorial (a record of the entertainment on vellum, with the signatures of those who joined in it attached,) was then presented to Dr. Hofmann.

The toast was drunk upstanding and amidst enthusiastic cheers.

German Song—"Lebewohl."

Dr. Hofmann, in responding, said:—Mr. Chairman, Gentlemen,—Allow me to convey my heartfelt thanks to you, Mr. Chairman, for the kind words — kind is an inadequate term—in which you have been pleased to propose my health, and to you, gentlemen, for the cordial manner in which you have received the toast. But, believe me, I do not misinterpret the true sense of these expressions. It is a genuine impulse of the human heart, on occasions like the present, at the moment of parting, to overlook a friend's shortcomings, and to keep only the bright side of his character in view. It is in this spirit that our President has given you a sketch of my English career. There would be no difficulty in turning the tables and revealing the many deficiencies of that career; no difficulty in showing how, on a closer inspection, the portrait which he has coloured so highly would fade into pale insignificance. But I value your esteem too much to wish to lower, even by a single tint, the picture which my friend has so flatteringly delineated. He must permit me, however, to complete his sketch by introducing into it the feeling of joyful gratitude with which I remember the countless manifestations of attachment I have received from all my English friends during my sojourn in this my adopted country. Their ever-ready counsel, their active support, their welcome sympathy, have never failed me on any occasion. And in glancing back at the many years of my happy labours in London, gemmed as this period is with delightful recollections, where could the expression of my gratitude find a more appropriate crystallisation-point, in which to centre, and from which to spread, than in our excellent President? He was among my earliest friends in this country, and, though he entered the College as a pupil, the brilliancy of his intellect, as well as the ardour of his aspirations, soon carried him far beyond that position, and placed him in the foremost rank of those who fostered the young and growing Institution in the early days of George Street and of Hanover Square. You all know these facts—you all know how soon his pupilage ceased, and how soon the student became the friend, the counsellor, one of the most able supporters of the new school—one of those to whose sound and practical advice we are so largely indebted for its safe steerage through the perils of its infancy. Truly, among the many feelings which affect me this evening almost overpoweringly, none is more joyful than that which moves my heart at the sight of my old and faithful friend presiding on this festive occasion—that well-tried friend whose hand was so frankly extended to me when first I reached the shores of this country, and now rests in mine with even warmer grasp on the eve of my departure. The delight I feel in seeing Mr. Warren De La Rue in the chair reminds me of another pleasure which you had destined for me by inviting Sir James Clark to this magnificent entertainment. I see the kindly countenance of our Chairman brighten at the very mention of the venerated name of his unremittingly active fellow-labourer in the cause of the College of Chemistry. That we are deprived of the pleasure of seeing him here this evening is owing to an attack of indisposition, from which, however, I am glad to say, he is now rapidly recovering. "You feel persuaded," he writes to me, "that no trifling cause could have possibly prevented me from attending." Of this I am perfectly sure, for no one was ever more deeply interested in whatever concerned the College of Chemistry than Sir James, and no one would have been more gratified to meet so large an assemblage of friends of the Institution. Of the zeal and energy with which he has worked for the College, of the time he devoted to it in its earlier stages, of this, as of so much good which Sir James has silently and unobtrusively performed, no echo has ever reached the public ear; but the recollection will remain deeply and indelibly engraved upon many a grateful heart. And while speaking of the early days of the College, how could we possibly forget, on this occasion, the many, now no longer amongst us, whose warm interest and active help so essentially contributed to the success of the Institution? The noble-hearted Prince, whose loss we shall never cease to deplore, was a staunch friend of the College, the establishment and the progress of which he promoted by his illustrious patronage. As for myself, I am free to acknowledge that, but for his kind intervention, I should probably never have been connected with the Institution. Nor is it possible ever to forget the generous exertions in the cause of chemical education of the late Lord Ashburton, whose time, wealth, and influence were always at the disposal of our supporters. Nor was it only in its earlier stages that the College was fortunate enough to secure the co-operation of powerful friends. At no period of its history have they been wanting. When, at a later period, the College became connected with the School of Mines, it enjoyed the special care of the late Sir Henry de la Beche. Need I tell you how we have fared under the auspices of his successor, our beloved chief, Sir Roderick Murchison? Let a single example of our many debts to him suffice. It is to him that the College owes its convenient Lecture-room. Before this acquisition the chemical lectures were delivered, as many of us remember, in the Theatre of the Museum of Practical Geology; which was a very great inconvenience, both for the students and the Professor. Sir Roderick no sooner became the head of the Museum than he perceived this anomaly, and found means of obviating it. It may be, perhaps, that his anxiety to centralise the chemical department of the School of Mines in Oxford Street was sensibly quickened, on certain occasions, by the wafted perfumes of escaping chlorine; perhaps it was fanned to a still higher temperature by some fragrant developments of sulphuretted hydrogen; and I secretly believe that it rose at last to the boiling-point on the occurrence of a little phosphorus conflagration, which one fine evening startled the peaceful inhabitants of Jermyn Street. But whatever share sulphuretted hydrogen and phosphorus may have had in the transaction, thus much is certain, that without the energetic determination of Sir Roderick, without his unremitting zeal, without his powerful influence, the College would be still deficient in one of its most essential appliances. But, Gentlemen, I have told you enough of the help which the College has received from without. Let me now speak to you of the support which the Institution has found within itself. No external props will sustain the tree unless the vital juices circulate freely through root, and stem, and branches. Need I tell you, Gentlemen, that the best pillars of the College have been the students who sat upon its benches, who worked in its laboratories, and who afterwards applied the knowledge there acquired, the patient habit of research there contracted, to the promotion of science, to the advancement of the arts, and to the benefit of mankind. And now, Gentlemen, I have reached a point at which I feel deeply the inadequacy of words to express the sentiment of proud delight, of joyous enthusiasm, with which I see myself surrounded this evening by this large assemblage of sometime students, many of whom were afterwards my assistants, all of whom are now my friends. In moments like this a man's existence is, as it were, concentrated; for, from the beaming eyes which meet mine, to whichsoever side they are turned, the happiest memories of my life come back, as if reflected from a mirror. Every face awakens a delightful tradition of years gone by, of successful collaboration, of mutual consolation in the hours of failure, of animated discussion, but always of good-fellowship and perfect understanding. Yes! this is indeed a golden moment, and one for which the labours of a lifetime would not be too high a price to pay. In glancing round this table my heart swells with an emotion of indescribable satisfaction. I see our beloved science of chemistry, as it were, vividly personified before me in all its noblest branches. I see here some of those who are gloriously devoting their laborious lives to the development of chemical philosophy—to the patient investigation of its recondite truths—to the discovery of new elements, to the revelation of new laws. In others here present I see represented the grand movement of industrial chemistry in our time; that movement which is covering Europe with factories, in which the transformations of matter are made subservient to the happiness of man. Prominent among such establishments are those from which innumerable exquisite colours are now so lavishly poured forth, to delight the eye and refine the taste of the masses with decorative splendours, which but a few years since even princes would have desired in vain. And as the word "princes" has escaped my lips, may I not venture to hint, in passing, at the lustre which science both gives and gains, when it sheds its light in palaces and receives the homage of "princes" in return? In such homage, nobly rendered, do we not recognise one of most marking signs of an age when all ranks unite in one ardent aspiration—to promote the happiness of humanity at large? But I am detaining you too long. "Out of the fulness of the heart, the mouth speaketh," and my heart is beating too high at this moment to be easily restrained. I would fain dwell upon the future of the College; I would fain stretch my vision through years to come, and forecast the destiny of an institution which will be dear to me as long as I live. That it will continually prosper, continually advance, the enthusiasm displayed in its behalf this evening would be earnest enough, were there not in its high mission, and in the abundant proofs of its utility, still stronger guarantees. It is with deep satisfaction that I reflect on the ability, so far superior to mine, of the distinguished chemist and esteemed friend who is about to preside over its destinies, and whose teaching, I have not the shadow of a doubt, will receive from the pupils of the Institution the same generous appreciation as you, my dear friends, in old student days, so affectionately accorded to me. But I must not enlarge on a topic which the programme, I see, reserves to be dealt with by abler hands; nor, indeed, must I any longer trespass on your indulgent attention. Let me, only for one moment, before I conclude, turn to those who represent here the rising generation of chemists, in order that I may point out to their emulation, the brilliant careers, and enviable positions, of distinguished men here present, but a few years since young students like themselves, now the conspicuous ornaments of our profession. Into whatever department of our noble science the pupil's inclination or capacity may lead him, he will find in this assemblage abundant proofs of the pre-eminence which, by the exercise of similar ability with equal perseverance, it is open to the youngest in his turn to attain. . . . My dear friends, I am putting off, I feel, that painful parting word, Farewell! But it must come at last—and I pronounce it in its fullest, deepest sense—may you, all and each, Fare well! Believe me, in quitting the glorious country of my adoption, in quitting dear old England, I carry with me to my new sphere of labour some of the brightest, some of the most cheering memories of my existence; and among the most consoling of my thoughts at this moment is the reflection that I may still hope for the happiness of meeting you again!

The next toast was proposed by Mr. Abel, who said:—There is probably no one of Dr. Hofmann's entertainers present this evening who does not experience, in some degree, feelings of affection for the institution in which we have all worked, and to whose existence we are indebted for our connexion, as his pupils and his friends, with the eminent chemist and teacher whom we delight to honour this evening. One is very apt to judge of other people's feelings by one's own, and I must say, and cannot help saying it now, that the six years which I passed at the Royal College of Chemistry were amongst the happiest years of my life. In company with Mr. Nicholson, I lately paid a visit to the Royal College of Chemistry on pleasant business connected with our meeting this evening, and in company with my old friend and colleague I once again, after an interval of many years, found myself in the old laboratory, the walls of which were blackened, not so much by age as by sulphuretted hydrogen. Once more I found myself on the old spot where I had many a time stood side by side with our great teacher, and where I can picture him to myself blowing softly and contemplatively into a watch-glass—(laughter and cheers)—looking intently into the dim distance at yet unformed crystals, which were to constitute some important member of one of the many "ammonia" families created and fostered by him, consoling himself that if they did not appear that day "he would have them to-morrow." (Laughter and applause.) As I looked round that room I could people each particular bench with a succession of well-known and well-loved faces—the faces of men with whom I had been associated year after year, some of whom had gone to far-distant lands, while others, alas! are now no more. The sympathies of Mr. Nicholson were more particularly directed to the very small and shabby room in which he had laboured indefatigably for years as the Doctor's right hand, and which has been the birthplace of most of those glorious researches with which Dr. Hofmann has delighted the world during the last eighteen years. Gentlemen, as I quitted the College that day, I thought, "Is it possible that the old place can ever get on without Dr. Hofmann?" So complete has been his identification with this institution, that it is almost impossible for me to think of them as otherwise than inseparable. We have heard from our Chairman of the difficulties with which the Doctor had to contend in the early part of his career in this country, and of the glorious manner in which he conquered those difficulties. He now leaves the College as a most successful Government establishment; but although its stability is secured, you will, I know, agree with me that its future position as a school of chemistry mainly depends on the manner in which the important trust of the prosperity of the Royal College of Chemistry is disposed of. And, therefore, gentlemen, all who have the welfare of the institution at heart must congratulate themselves in finding that trust confided to one of the most zealous and successful investigators of chemical science of whom England, or even the world, can boast. Gentlemen, I ask you to drink to "The future prosperity of the Royal

College of Chemistry," and to associate with this toast that of the health of Dr. Hofmann's successor, Professor Frankland. (Loud cheers.)

The toast having been duly honoured,

Professor Frankland, in responding, said: When I look around me in this room and see the numerous assemblage of men who have studied in this Royal College of Chemistry; when I remember the position which they occupy at the present day; when I call to mind the researches which have been made in that institution; when I consider the influence which these researches have had upon the chemistry of the world,—how the practice of this our beloved science has to a great extent been moulded during the last twenty years by many of those researches—I cannot help feeling the responsibility cast upon the successor of the gentleman who has so successfully raised the institution to its present brilliant position. If earnestness of purpose and love for our science could secure success in carrying on this establishment during the absence of Dr. Hofmann, I should feel no fear of failure. (Hear, hear.) But, unfortunately, other qualities are necessary. There is the power of organisation, there is the method of management and the tact of arrangement in these matters, and last, though by no means least amongst them, is the sympathy of those who have been connected with such an establishment, and especially of those who have been connected as students with it. From the manner in which you have just drunk my health, I cannot but feel secure in this last help to my success. ("Bravo!" and cheers.) I am sure in this respect every student of the Royal College of Chemistry will do his best, by sympathy, by advice, and by suggestion to render possible the carrying on of this great school during what I may term its interregnum, in a manner which shall not, at all events, bring disgrace upon it. I hope, gentlemen, I may rely upon your sympathies and co-operation in this respect, and if I can do so I shall enter upon its duties with very considerable hopes of not, at all events, utterly failing in their performance. (Applause.) In conclusion, allow me to thank you for the very kind manner in which you have expressed your wishes towards me on the present occasion.

The Chairman said there was one thing not noticed in the programme, and that was, a kind proposal on the part of Mr. Belton to present each gentleman with an excellent photograph of their Professor. (Applause.) It suggested the thought that they ought each to present the Doctor with their photographs as a memento of the occasion. (Cheers.)

The photograph, a very excellent one, was taken by Messrs. Wilson and Beadell, of New Bond Street.

Dr. Odling: The honourable task, the pleasant duty, has been assigned to me to propose that we should all of us unite with a heartiness and earnestness, only one degree inferior to that in which we have given welcome to our distinguished guest this evening, in drinking success to the Society in which he was so much interested, and of which he was so great an ornament—the Chemical Society. (Hear, hear.) We have heard Dr. Hofmann eloquently eulogised this evening as a great master; I have to propose that we should bear him in our memories as a great "Fellow,"—in fact, a grand Fellow of the Chemical Society. (Cheers.) We can call to mind many lively evenings which we have spent in his society, those in which he filled so well the dignity of the chair; but, at the same time, they were not the most lively, for I preferred to see him standing on the floor and expounding, with all the enthusiasm of his nature, some of those recondite problems which he knows so well how to illuminate; to see his face light up a touch of sympathy in his auditors, and his eloquent right hand protruding itself when he thought that they appreciated the point. ("Bravo!" and applause.) I say, gentlemen, we must bear in mind our distinguished friend not only as the teacher and philosopher, but as our Fellow on those boards. But, Sir, my toast has reference not so much to the past as to the future; I have to call upon you to drink success to the Chemical Society—to its future career. I am sure that we shall all of us feel it a duty to support the Society with our most earnest efforts now that we feel how great a prop has been removed from it, at any rate for a short period. I am sure it will be a source of gratification to Dr. Hofmann, as it is to all of us, to feel that we have now occupying the chair so able a chemist and so accomplished a gentleman as Dr. Miller. We of the younger generation are deeply indebted to Dr. Miller, not only for the scope of learning which he has placed at our disposal, but also for the admirable example which he has set. Dr. Miller is not wedded to the notions which prevailed in olden times; but he has shown that he is seeking truth only, and truth for its own sake, and by so doing, with a large amount of industry and a large amount of activity, he has placed himself in the advanced guard in the progress of chemical science. Gentlemen, I call upon you to drink success to the Chemical Society, and to associate with it the name of Dr. Miller. (Applause.)

Dr. Miller, in responding to the toast, said: I consider it an exceedingly happy circumstance that the lot has fallen to me to occupy the chair at the Chemical Society; and that it has been my good fortune by so doing to be able to be present at such a gathering as this. I have not had the honour of being one who has worked in his laboratory, and therefore, but for the accident of your having, a short time ago, been kind enough to place me in the chair, I should not have been able to have witnessed the enthusiasm which has greeted my admirable friend Dr. Hofmann from his old pupils on this occasion. It is a circumstance that cannot be effaced from the memory of any of us; as long as we preserve memory we shall preserve the recollection of this night. But, gentlemen, it is not my part to speak of the feelings which have filled my heart whilst I have listened to the address which we have had on this occasion. I am called upon to respond to a toast in which prosperity to the Chemical Society is the main staple. When I see around me so large a body of supporters of that Society, I believe that there have been within the last quarter of a century two great events in the chemical history of England—the one the establishment of the Chemical Society, and the other the establishment of the College of Chemistry, under the guidance of Dr. Hofmann. (Cheers.) Gentlemen, I may say those two events were necessary to each other. The one would scarcely have been a success without the other. Not that Dr. Hofmann would have failed—far from it; but in order that we may succeed we must have a sympathising audience, and such an audience was provided when the Chemical Society was established. Success naturally causes, as our friend says, crystallisation round a nucleus, and that nucleus here has been the Chemical Society. It gave us the opportunity of establishing what we have now—a chemical journal. It gave the opportunity of speedily promoting the knowledge of those discoveries which were made in the laboratory of the College of Chemistry and of other institutions, which speedily were stirred up to increased activity by the example there set. Before the establishment of the Chemical Society I believe we might have told off upon our fingers the names of the chemists of England. Since the day that we established that Society, this assembly represents but a small number of those who are engaged in pursuit of that noble science. (Hear, hear.) My friend Dr. Odling has alluded to the loss we are sustaining in the departure of Dr. Hofmann for a time from this country; but I hope that departure does not necessarily involve the loss of those admirable communications which he made, and which we hope he will continue for many, many years to make to our knowledge. As a great general society, we are entitled to have from him the first fruits of his labours. (Hear, hear.) Why should not this be the country in which his labours are given to the world, although he considers it the prime duty of a patriot to stir up in Germany the flame which he has kindled in this country? Gentlemen, I hope, therefore, in losing Dr. Hofmann's bodily presence we do not lose his mental activity amongst us. For the future of the Chemical Society, I really feel very little fear. We are supported by chemists who are known throughout the world, and who are contributing discoveries of magnitude and importance week by week. Whilst those discoveries are going on, and whilst we have such officers as Dr. Odling and Dr. Frankland, with others whom it would be invidious to name, we can have no fear for the future of chemistry or of the Chemical Society in this country. I thank you most heartily for the kind manner in which my name was associated with this toast, and I thank those gentlemen who gave me the opportunity of being present on this occasion, and I hope we may welcome our friend back again as warmly as we celebrate his departure. (Cheers.)

The Chairman, in giving the next toast, said: If proof were required to be adduced of the value of the College teaching, of which we have already heard so much, it would be brought forward in the diversity of callings and social positions of its students. Without arrogating too much to ourselves, I think we may say that we form a glorious brotherhood, united by the love of truth; that we are an assemblage of men who have not shrunk from hearty, consistent work when any worthy object has been presented to us. (Applause.) It is not to be expected that in our after-career we can all devote the same time to abstract chemical research; but the high-born and those lower in the scale of social position must derive not only a new source of enlightened pleasure, but also a powerful means of effecting good from the study of so glorious a science (hear, hear). We have amongst us to-day three princes whose destinies time alone can unfold. (Cheers.) They have not deemed a knowledge of chemistry unworthy of a place alongside of their other high mental attainments; and I regard it as a gratifying symptom of this age that princes not only patronise science, but that they make themselves intimately acquainted with it. (Applause.) I would ask you to drink the health of our distinguished colleagues, their Royal Highnesses the Comte de Paris, the Duc de Chartres, and the Prince de Condé. (Cheers.)

The Comte de Paris, in responding, said: Gentlemen, I did not come here to make a speech. Even if I am entitled to say anything about our beloved guest, I feel that it is unnecessary amongst you who know him and love him so well. Therefore I wish only to thank you in the name of my brother, the Duc de Chartres, and my cousin, the Prince de Condé, for the unexpected compliment which has been paid to us to-night, and to tell you how heartily we join with you in the mark of regard, admiration, and I dare say, of affection, which has been paid to Dr. Hofmann. (Cheers.) As foreigners in this country and strangers amongst you, we feel bound to you by one common feeling of gratefulness towards our former master. Therefore let us all join to tell him that whenever he comes back to this country, and we hope it may be soon, he will find as many friends amongst us here as he has ever had pupils during the long years he has sojourned amongst us. (Loud applause.)

Mr. Nicholson (who was greeted with loud cheering) said: Fellow students, as one of the oldest amongst you, I perhaps may have the privilege of speaking. I shall detain you but a few seconds, as I have the honour of proposing the last toast of the evening. I think, gentlemen, by the expression on your faces, I may say that this entertainment is a success. (Applause.) I think it is a success to Dr. Hofmann—(Cheers),—and I think it is a success to ourselves. If there is one person to whom we are indebted for this little gratification, it is to the exertions of our worthy Chairman, Mr. Warren De la Rue. ("Bravo" and cheers.) His many qualifications and his eminence as a scientific man have been spoken to by Dr. Hofmann and others this evening; therefore I need not take up your time by at all mentioning my own opinions on the subject. It is sufficient for me to say that he is a well-known man, that if a letter were directed to him from the uttermost parts of the earth directed simply "Mr. Warren De la Rue, England," it would find him without a single hitch in the postal delivery. It is not as a scientific man I wish you to drink his health, but as president of this glorious entertainment this evening, and I know you will do this most enthusiastically, and, if I dare say it, let us drink it, as we used to do, of old, for "he is a jolly good fellow."

The toast was drunk with musical honours.

The Chairman: Gentlemen, if I could respond in music I would. (Laughter.) I assure you I thank you with all my heart for the cordial manner in which you have received the proposal of my much esteemed friend Mr. Nicholson to drink my health. My warmest sympathies are bound up with the welfare of the College, and I look upon the testimonial which I received in 1847 as one of the most gratifying recognitions of services rendered to science that I have ever received. This was given to me at the meeting presided over by his late Royal Highness the Prince Consort, and I keep it as a precious memento. Three names on the testimonial have passed away—the names of great friends to the College; and we shall all pass away, but when we are all gone, the College will still endure. But there is an immense amount of vitality yet in the College and in its pupils, and while we live I hope that we may often be brought together in such convivial evenings as the present. (Loud cheers.)

The company then dispersed with unmingled feelings of satisfaction at the success of the entertainment.

Great credit is due to Messrs. Abel, Nicholson, Maule, and Field, to whose exertions, as the Executive Committee, must be mainly ascribed the great *éclât* of this parting demonstration to Dr. Hofmann.

Mr. Harker officiated as toastmaster.

Additional Clauses for the Pharmacy Bill.—The Leeds chemists and druggists have brought forward the following additions to the Pharmacy Bill:—Clause 1.—And it be enacted, that on and after the 1st day of January, 1866, the license, now known as the license for the sale of patent medicines, be discontinued and repealed, and in place of the aforesaid license, another license which for the purpose of this Act shall be called the "Pharmacy License" be substituted, the value of which shall not exceed 40s. Clause 2.—And be it also enacted, that any person or persons keeping open shop for the sale of drugs, chemicals, compounds, patent medicine, other medicine or medicines, or causing to be sold for the cure of disease or diseases, any such drug, chemical, compound, patent medicine, other medicine or medicines, not having taken out the said Pharmacy License, shall for each offence be subjected to a penalty of   for each offence, or twenty-eight days' imprisonment, as the magistrate or magistrates may direct. Clause 3.—And be it also enacted, that the meaning, rendering, or definition of the words, "drugs, chemicals, or compounds," shall be any article, simple or compound, named or described in the British Pharmacopœia, unless the said article be distinctly marked in a schedule to certify the free sale thereof. Clause 4.—And be it enacted, that all the essential clauses relating to the putting up for sale or illicit sale of patent medicines, shall be in all respects the same as the clauses already enforced in the Act now in use and known as the Patent Medicine License.

ANSWERS TO CORRESPONDENTS.

M. A. B.—Received.

A. B.—It is used cold. The price depends altogether upon the quantity required. It can be produced very cheap.

Excelsior.—Try a solution of gallate of iron in ammonia.

R. M. Atkinson.—Received with thanks. Came too late for any remarks this week.

THE METALLIFEROUS MINES BILL.

We have before us the Metalliferous Mines Bill brought in by Lord Kinnaird, and we consider it our duty to give an opinion on a subject so important to an art which was probably the parent of chemistry, and concerning which that science is still so much interested. To those who have read the report of the late Mines Commissioners it will be clear that many remediable evils were proved to exist. The Commissioners gave opinions concerning these remedies, and the Bill seeks to insist on their application.

We shall be grievously disappointed if English gentlemen and statesmen will allow another year to pass over without endeavouring to remove the dangers under which such an important part of the community are compelled to exist. We understand that the owners of and workers in mines are well pleased with the Bill, and that it would readily be passed if the Government did not oppose.

We may enumerate some of the demands:—That ventilation shall be sufficient; that mechanical appliances for lowering or raising men shall be used when the Board demands it (the Board of Trade is here meant); that ladders, ropes, &c., &c., shall be kept in good condition; that indicators shall show at what place of the shaft the lifting machine may at any time be; that it shall be supplied with a break (we suppose this is in cases where no man engine is used); that every skip or cage shall be covered when used for lowering or raising the miners; that single-linked chains shall be avoided; that proper fencing shall be made; that shafts shall be lined wherever the natural strata are insecure; that all shafts shall be fenced when a part is used for men and a part for other purposes; that every mine entrance, every shoot, winze, or sump not in use shall be covered; that sufficient accommodation be given for drying clothes and changing them; that steam engines shall be provided with water gauges and safety valves and with steam gauges or whistles; that the fly wheels shall be fenced; and that very young persons shall not work in the mine.

These general requirements are to be supplemented by rules made according to the requirements of each mine, which rules shall be made by the proprietors and shall require the sanction of the Board. If there is any dispute it is to be settled by arbitration. Probably such precautions to protect the proprietors from being compelled to act according to any unreasonable demands of any public officers were never before given in a Bill.

The plans of the mine are to be deposited at the office of the Board, if not already deposited at the Mining Record Office. Some confusion might arise from this, and it is, perhaps, too much to demand that two sets of plans shall be deposited. Perhaps it might be sufficient to say that plans shall be deposited if required; but this is perhaps of less importance.

For the purposes of the Act the Board may appoint such inspectors as are required to report on the condition of the mine and all matters relating to the safety and health of the miners. The Board will give such orders as the inspectors' report shows necessary, and if objection be made it is to be settled by arbitration, the Board and the proprietor each appointing an arbitrator, and both together an umpire. If this fails the Board may cause a second arbitration, and appoint two arbitrators and an umpire. The question to be settled in three months, unless the Board extends the time. We do not suppose that there are two opinions on the propriety of having the work done. Shall men be compelled to do it, or shall we leave it to their own good sense? It is rather strange to hear men speaking so, when it has been left to their good sense since the world began. We do not doubt the willingness of mine owners to do their work well, including attention to the men; but in most cases they do not know what to do. The value of inspectors consists chiefly in this, that they convey knowledge from place to place —knowledge of a high class, and in this case such knowledge as the Mining Commission have made public, but which we know, from experience, the proprietors of mines will not read, learn, and inwardly digest, unless they are assisted.

Men willingly receive the instructions of an inspector if given in a proper manner. They are glad to hear his experience, and they frequently find that he saves for them a considerable amount, as he shows the manner in which certain work can best be done, instead of leaving it to the owner to discover it for himself. The inspector may make himself a friend to all the proprietors and working miners, and be welcome wherever he goes. We are told of a mine belonging in part to a distinguished statesman, which was losing money for years; the precautions recommended in this Bill were taken, and the improved mechanical appliances used largely, and the mine is now paying its owners many thousands of pounds yearly. The humanity was carried out for money, but nature was kind, and took the *deed* for the *will*. We believe that the method of working mines spoken of is become a necessity if mining is not to cease in many cases. The time is past when carelessness or unwholesomeness can make a living even underground.

We are chemists, and must look on the matter as such. The inspectors appointed to superintend the ventilation must have chemical knowledge. Men have used their senses in various ways to ascertain whether a place is well or ill ventilated, but have failed. Now, however, we can tell by a simple experiment in a few seconds the exact condition of the ventilation. Chemistry is seizing more and more on the reins of industry, and directs it successfully where mechanics have failed and the senses have been uncertain. The evil is a chemical one, the cure must be chemical.

We believe the Board would have very little to do with the matter. The inspector would report to the owners first. Although this is not in the Bill, we think it advisable, and we believe that it acts best; the owner will see the reasons when they are pointed out for any change, and the inspector will only require to report to the Board that such changes are making or made. It is important to remember that much will depend on the character of the inspectors. If they report every little evil first to the Board, and cause a demand of change to be made, it may induce opposition. We as Englishmen believe we can be led by reason, but we are hard to drive. Let the instructions to the inspectors be that they are to teach the miners those facts and principles which a careful public inquiry has shown to be conducive to their welfare. The miners themselves, masters and men, will be the chief gainers, but the whole community will gain, and the mining speculations will less often be merely modes of absorbing the surplus money of the community.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On a Yellow Colouring Matter from Rosaniline, by Max Vogel.*

When a strong stream of nitrous acid is passed into an alkaline solution of commercial fuschine or pure rosaniline some magnificent colour phenomena are observed. In a short time the red colour passes to violet, and this to a beautiful blue; by the continued action the blue changes to green. On allowing the green solution to stand for some hours, the green colour changes to a beautiful reddish yellow, but this change may be quickened by continuing to pass the nitrous acid. The colour undergoes no further alteration, and on evaporating this solution on a water-bath a reddish-brown pasty mass is obtained, which hardens on cooling, and when cold can be reduced to a beautiful cinnabar red powder.

The author has made one analysis of this powder, from the results of which he deduces the formula $C_{16}H_8NO_6$.

The new colouring matter behaves as a base and as an acid. It dissolves with some difficulty in dilute, easily in concentrated acids, but more easily still in alkalies. Acids separate it from alkaline solutions, the colour floating on the surface of such solutions as a flocculent mass. The colour dissolves in alcohol, sulphide of carbon, chloroform, and ether, but is insoluble in water.

The author intends to continue the study of this body and to make experiments on the action of nitrous acid on aniline blue, violet, green, &c.

Researches on Cerium,† *by* R. Hermann.

Rammelsberg having published (*Repertoire de Chemie pure*, ii., 6) a paper on cerium, the results of which do not agree with those previously arrived at by the author in 1843, the latter has undertaken some new researches on oxide of cerium.

Sesquioxide of Cerium.—Sesquioxide of cerium is formed by the calcination, in contact with the air, of a mixture of ceroso-ceric sulphate and carbonate of soda; 58·785 per cent. of oxide Ce_2O_3 is thus obtained. On the other hand, 100 parts of the same salt furnish, after being dissolved in sulphuric acid, and calcined, a quantity of sulphate corresponding to 54·881 of protoxide of cerium; it follows that 100 parts of protoxide correspond to 107·11 parts of sesquioxide of cerium, these figures agree well with the equivalent 46 of cerium ($H = 1$).

Concentrated sulphuric acid partly decomposes this oxide, giving a ceroso-ceric sulphate of variable composition.

Again, sesquioxide of cerium is formed by the action of heat on cerous oxalate in presence of air. Rammelsberg has admitted that in this case the oxide $CeO.Ce_2O_3$ is formed.

Peroxide of Cerium (Ceriumsupersuboxide).—The author formerly obtained by calcining cerous nitrate, an oxide superior to the sesquioxide, and having the composition $2Ce_2O_3.CeO_2$.

This is also formed by calcining sesquioxide in a current of oxygen, while Rammelsberg admits that in this case an oxide is produced $(CeO)_2(Ce_2O_3)_5$.

The author attributes this opinion to Rammelsberg's having regarded the sesquioxide, obtained by the calcination of the oxalate, as ceroso-ceric oxide. The density of this peroxide of cerium is equal to 5·759, while that of the sesquioxide is equal to 6·0. Sulphuric acid decomposes peroxide of cerium, disengaging oxygen, and giving a mixture of cerous and ceric sulphates.

Sesquioxide of cerium treated by sulphuric acid gives a mixture of red and yellow sulphate in varying proportions, and at the same time oxygen is disengaged. These two sulphates crystallise separately.

Red Sulphate.—This salt, crystallising in hexagonal prisms, resembles bichromate of potash. The first analyses of this salt led the author to assign to it the simple formula $Ce_2O_3.3SO_3 + 9HO$. M. Marignac supposed it to contain cerous oxide, and M. Rammelsberg gave it the formula $3(CeO.SO_3) + Ce_2O_3.3SO_3 + 18HO$. The author's more recent researches have changed this formula to $2(CeO.SO_3) + Ce_2O_3.3SO_3 + 27HO$, of which the numbers agree better with those of M. Rammelsberg than the formula given by this chemist.

Yellow Sulphate.—This salt, which is deposited from the mother liquors of the preceding, crystallises confusedly. M. Rammelsberg attributes to it the formula $CeO.SO_3 + Ce_2O_3.3SO_3 + 8HO$; and the author gives the following:—$2(CeO)_2(SO_3)_3 + 3(Ce_2O_3.3SO_3) + 42HO$. It has probably no invariable composition.

Basic Ceroso-ceric Sulphate.—This salt is formed by the action of water on acid sulphate; in colour it resembles precipitated sulphur; its composition varies with that of the acid sulphate from which it is formed. M. Marignac ascribes to this salt the formula

$$3(CeO.SO_3) + 2Ce_2O_3.SO_3 + 7HO.$$

and M. Rammelsberg $2(CeO.SO_3) + 2Ce_2O_3.SO_3 + 6HO$.

The author has obtained, with red and with yellow sulphate, a basic salt, having the formula

$$4(CeO.SO_3) + (Ce_2O_3)_3(SO_3)_2 + 12HO;$$

and with ceroso-ceric sulphate, containing $CeO.Ce_2O_3$, another salt $3(CeO,SO_3) + (CeO)_{11}(SO_3)_2 + 5HO$.

Cerous Sulphate.—Cerous sulphate combines with different proportions of water. MM. Otto and Beringer have described a sulphate $2(CeO,SO_3) + 3HO$.

By treating calcined cerous sulphate, which is more soluble cold than hot, by a very little water, we obtain, by gradually raising the temperature, four different salts containing—

$$3(CeO.SO_3) + 5HO.$$
$$CeO.SO_3 + 2HO.$$
$$3(CeO.SO_3) + 8HO.$$
$$CeO.SO_3 + 3HO.$$

When once a crystal is formed in a solution all that follow are of the same composition; unless, indeed, the mother liquors are decanted, in which case crystals of different composition may be formed.

The salt with five-third equivalents of water forms prisms grouped in bundles; exposed to the air, these crystals lose their transparency, and absorb water.

The salt with two equivalents of water forms rhomboidal prisms, also in bundles, and losing their transparency by exposure to the air.

The salt with eight-thirds of water is most frequently produced; it forms short, thick, rhomboidal prisms, which do not change in the air. Its composition corresponds to that of sulphate of didymium with eight-third equivalents of waters; but differs from it in its crystalline form, as it crystallises in the monoclinic system.

The salt with 3HO has been frequently observed, especially by M. Czudnowicz; it is in the form of prisms with six sides, surmounted by a pyramid; it does not alter in the air.

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* *Journal für Praktische Chemie*, vol. 94, p. 128.

† *Ibid.*, cxli., 113.

TECHNICAL CHEMISTRY.

On the Chemical Effects of Incandescent Fuel on Steam Boilers, and the Chemical and Physico-Chemical Effects of the Feed-water, by F. A. PAGET, *Esq.*, *C.E.*

WE extract the following from a very valuable paper "On the Wear and Tear of Steam Boilers," read by the author before the Society of Arts:—

Whatever physical changes may be induced in iron by the long continuance of a high temperature which is not succeeded by the application of the impact of the hammer or the pressure of the rolls, it is certain that long continued red heat leads to the loss of its metallic consistency. Its surface gets converted to a greater or less depth into forge scales, which, according to Berthier, consist of a crystallised compound of peroxide and protoxide of iron. The mechanical action of the gases—and especially of the free oxygen contained in every flame—forced at a high velocity by the draught past the more or less heated plates, would also aid these chemical combinations—upon the same principle as iron filings, thrown through a gas flame, burn in the air; and upon the same mechanical principle as the incandescent lime is worn away by the flame of the oxyhydrogen blowpipe. These actions would take place with any fuel, even with pure charcoal. But when mineral fuel, which mostly contains more or less iron pyrites, is used, there is much more danger to the plates, especially over the fire, in getting red hot, as the flames would then hold sulphurous acid, and often volatilised sulphur. A familiar illustration of an action of this kind is afforded by the fact that a piece of red-hot iron plate can be easily bored through by means of a stick of sulphur, the combination forming sulphide of iron. Dr. Schafhaeutl, of Munich, has given great attention to the changes in plates subjected to the action of fire; twenty-five years ago he read a paper before the Institution of Civil Engineers,[*] and more recently he has published an essay, both on this subject, in a Munich periodical.[†] He has brought forward a number of facts, founded on chemical analyses of plates of exploded boilers, showing the danger, due to chemical action alone, when the plates of a boiler become red hot. He notices that the iron of the inside of the plates, in getting red hot, decomposes the water, and combines with the oxygen thus freed. It also loses some of its carbon. The outside combines with the free oxygen and with any sulphurous acid in the flame. He states that iron made with pit coal is much more affected than charcoal-made iron; becoming laminated at the original joints in the pile out of which the plate has been rolled. It is possible that portions of oxide are carried into these joints, and it is at any rate certain that iron gives way easiest at these places. This points to the great value of really homogenous plates, such as those of cast steel, in which homogeneity has been obtained by the only known means of fusion. The remarkable diminution of elasticity and of tenacity caused by the combination of the red-hot iron with sulphur; the absence of all elasticity and tenacity in the oxides of iron, show that, even if a flue do not at once collapse, or a shell explode, through getting red-hot, the boiler is more or less injured every time it gets overheated. A defective circulation, by permitting such a temperature as to drive the water off the plate, would soon lead to local injury. Particular spots in externally fired cylindrical boilers are sometimes, as is stated by Mr. L. Fletcher, of Manchester, thus affected, and in an apparently mysterious way. A new boiler in which a heap of rags were accidentally forgotten, had the spot burnt out in a few days,[‡] doubtless through the resulting defective circulation and its consequences. The plates just above the fire of internal flues also suffer in this manner. It is perhaps possible that turned joints, secured by bolts, and allowing an occasional reversing, or rather rotating, of the ring, might, in some cases, be here of service. At any rate, universal experience proves that the thicker the plate the easier does it get red-hot; and these chemical facts also point to the desirability of a minimum of thickness. In fact, the wearing away of the plates through these causes, if mechanically strong against pressure, often gets arrested at a certain thickness. In Germany and France, some of the best manufacturers still make the plates over the fire of, for instance, inside flues, slightly thicker than anywhere else; but the combined chemical and mechanical actions of the heated fuel cause most wear and tear in a thick plate, and thus justify American practice in this respect. In that country, fire-box plates of good charcoal iron are made only $\frac{1}{16}$th or $\frac{1}{4}$th of an inch thick, and, with stays four inches apart, give good results under nearly 150 lbs. steam pressure.

The wear and tear of a boiler which occurs in the form of corrosion, properly so-called, may be divided into two principal kinds:—(1.) Internal, and (2.) external. The progress of both is necessarily intensified by the mere effects of temperature; each, however, has its strongly-marked, distinct character—not merely as to position, but also as to origin and results.

A steam boiler is in the position of a vessel into which large volumes of water are continually forced; while the heat applied, driving off all volatisable matter, leaves behind a concentrated solution with a chemical character dependent on that of unvolatisable matters in the feed water. The specific gravity of the substances found in the water naturally causes them to sink towards the bottom, at which part the solution is generally more concentrated, however much it may be stirred up by the ebullition. Mr. J. R. Napier lately stated that a piece of zinc "about four feet long, by three inches broad, by three-sixteenths thick, placed in a marine boiler for three weeks" to a depth of eighteen inches in the water, showed a corrosion which rapidly decreased "up to the highest part, which, in the steam, appeared to be little affected."[§] This accounts for the fact that all boilers, even those internally fired, like locomotive boilers, have their plates most affected towards the bottom, and that internal corrosion always shows itself to a greater extent below the water line. The *bouilleur* of the form of boiler known as the French boiler is also generally more affected than any other part. To resist this sort of slow action, it is clear that the more the bulk of metal the better, and it is for this reason that the bottom plates of most marine boilers are made thicker, while these same plates in locomotive boilers have to be often renewed. Any chemical or physico-chemical action of the kind is of course intensified by temperature, and this is one of the causes why externally fired boilers give way most a little in front of the furnace. But the plates above the water-line also get more or less corroded, and not merely with the usual character of rusting, but in that peculiar form known as pitting, which generally

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[*] *Transactions* of the Institution of Civil Engineers. Vol. iii., 1840, p. 411.

[†] *Bairisches Kunst und Gewerbeblatt.* June, 1863.

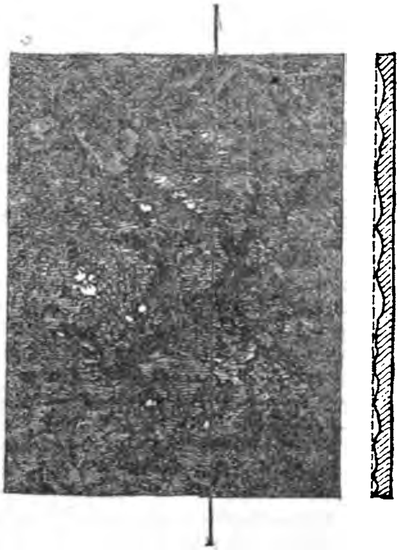
[‡] Péclet, "Traité de la Chaleur." Vol. ii., p. 71.

[§] Institution of Engineers in Scotland, Session 1864—5.

shows itself much more strongly marked below the water-line.

The presence of a concentrated solution of an acid or alkaline character, kept at a high temperature for years in contact with iron plates, would be sufficient to account for much corrosion. But the internal corrosion of steam boilers has many features of such a mysterious character, that no accredited explanation of its attendant phenomena has yet been put forward. In the first place, plates thus attacked show a number of irregular holes like a pock-marked human face, or like the small craters seen on the moon's surface. (See Fig. 1.) The writer has also sometimes observed two or three little irregular excavations like this in a plate otherwise showing a large surface quite intact. Sometimes the plate is most pitted round a projecting bolt; at others, one plate will be perfectly sound, while that rivetted to it will be almost eaten away, both having been the same time at work, and under, of course, apparently exactly similar conditions. With locomotive boilers this pitting has been ascribed to galvanic action between the brass tubes and the iron plates. But it is notoriously well known to locomotive superintendents, that boilers with iron tubes are often worse pitted than those which have run the same distance with brass tubes. Besides, all iron boilers, with or without brass, whether used for stationary, locomotive, or marine purposes, are subject to pitting.

Fig. 1.



The internal surface of a plate of an old wrought iron boiler, showing one-quarter of the full size, the ordinary appearance of pitting.

(To be continued.)

Ammonia and Nitric Acid in Hail.—We have mentioned before that Professor Reichardt has discovered the presence of nitric acid and ammonia in hailstones, and now only give his numerical results. In a million parts of hail he found 3·247 ammonia and 0·526 of nitric acid. These determinations agree closely with those of Boussingault, who found in a million parts of rain water 2·08 ammonia and 0·83 nitric acid. Professor Reichardt also determined the specific gravity of the hailstones. Two kinds fell, one opaque, and the other glassy and transparent; the former had the sp. gr. 0·9234, the latter 0·9285.—*Chem. Central Blatt.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, May 4.

Professor W. A. Miller, *M.D., F.R.S., President, in the Chair.*

The minutes of the previous meeting having been read and confirmed, and a long list of contributions to the Society's library duly acknowledged, Mr. Arthur S. Hobson was formally admitted a Fellow, and signed the statute book. The ballot was taken for the election of Dr. Holzmann, Marlborough House; Mr. Joseph Sugden, jun., Halifax; and Mr. Thomas Nesham Kirkham, Gilston Road, West Brompton—all of whom were declared to have been unanimously elected Fellows of the Society. The name of Mr. William A. Tilden, Demonstrator of Chemistry in the Laboratory of the Pharmaceutical Society, was proposed for the first time, and the certificates in favour of the following candidates were read for the second time—viz., Mr. Thomas Fairley, Medical School, Leeds; Mr. Edward Swann, Director of the Laboratory at the London and North Western Railway Company's Works, Crewe; and Mr. Alfred Upward, Superintendent of the Chartered Gas Works, 148, Goswell Street, London.

A paper on "*The Phosphide of Magnesium,*" by Mr. Thomas P. Blunt, was read by the Secretary. The author prepared this substance by passing the vapour of phosphorus over heated magnesium filings in an apparatus, filled, in the first instance, with carbonic acid gas. The heated metal became incandescent in the act of combination, but a small proportion of magnesium usually escaped the action of the phosphorus; the author found, however, in a carefully conducted synthetical experiment, that 2·4 grains of magnesium absorbed exactly two grains of phosphorus; the percentage composition of the product was therefore—

Magnesium	54·54
Phosphorus	45·46

Numbers which agreed pretty closely with the formula—

$$Mg_3P.$$

In the state of purity the phosphide had the general appearance of lamp black, and was found to be remarkably permanent, so much so that hydrochloric acid failed in exerting any action upon it, and it was only by long boiling with nitro-hydrochloric acid that it underwent solution. If, however, a mixture of the true phosphide, with excess of metallic magnesium, were acted upon by dilute hydrochloric acid, a copious evolution of non-inflammable phosphoretted hydrogen ensued.

The next communication, entitled "*On the Periodides of Some of the Organic Bases,*" by Mr. William A. Tilden, was also read by the Secretary. The author had made experiments, which resulted in the discovery of several new compounds, having a constitution very similar to that of Dr. Herapath's iodo-sulphate of quinine, and possessed of like optical properties. The first of these was made by mixing an alcoholic solution of caffeine with hydriodic acid and exposing for some time to the air, when a gradual separation of beautiful metallic green prismatic crystals was the result, the analysis of which led to the formula

$$2(C_8H_{10}N_4O_2HI_2),3H_2O.$$

On attempting to prepare this body by the direct action of iodine (dissolved in alcohol) upon the sulphuric or hydriodic acid solution of the base, the author obtained small black granules, which contained 75 per cent. of iodine, or an increase of 12 per cent. upon the amount found to be present in the lustrous green crystals. By the use of a standard solution of hyposulphite of sodium, it was ascertained that a certain proportion of the iodine—viz., two-thirds—existed in a free state, or "*exterior*" to the original molecule, and, therefore, in a condition under which it was recognisable by starch. By heating caffeine with iodide of ethyl to the temperature of 130° C. for about four hours, hydriodic acid was formed with liberation of a little free iodine, and a liquid product obtained, which, upon evaporation, furnished brilliant brown scales of a permanent character, and insoluble in water. Its analysis indicated the formula $(C_8H_{10}N_4O_2C_2H_5I)I_2$. A corresponding periodide of methyl-caffeine was formed with even greater facility than the body last named. Lastly, the author had prepared and submitted to analysis the iodo-strychnine of Pelletier, and proposed for this substance a formula containing one atom of hydrogen more than formerly admitted; thus—

$$(C_{21}H_{22}N_2O_2HI)I_2.$$

Several experiments were made upon aniline and other organic bases with the view of obtaining combinations of a similar character, but the results were either indefinite or altogether unsuccessful.

In answer to an inquiry on the part of the PRESIDENT, Mr. TILDEN said he had not yet examined the optical properties of the teriodide of tetrethylammonium, and could not say whether or not the crystals were suitable for use as artificial tourmalines. In reply to Dr. Redwood, the author stated that he had been unsuccessful in producing Herapath's salt by the addition of iodine to the hydriodate of quinine; the employment of the sulphate of this base appeared to be absolutely necessary.

The proceedings were brought to a close at an early hour, and the meeting adjourned until the 18th inst. It was announced that on the occasion of the next succeeding meeting, June 1, the President would bring forward for discussion "*Some Points in the Analysis of Potable Waters.*"

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, April 28.

"*On the Food of Man in relation to his Useful Work.*" By LYON PLAYFAIR, C.B., LL.D., F.R.S.

1. The great generalisation of Liebig, that food contains two chief classes of organic ingredients, one class consisting of nitrogenous substances, which give the plastic materials for the formation of tissues, while the other class contains the amylaceous and saccharine bodies destined to support the heat of the animal body, has met with general acceptance, notwithstanding the objections entertained by some physiologists to the general terms of the division. They state that the nitrogenous aliments may also support animal heat, as well as fulfil their special function of forming the tissues. But the distinguished author of the classification admitted this fact in his first work,[*] when he pointed out that the carnivora must waste their tissues in the support of animal heat. The recent experiments of Bischof and Voit,[†] and of Pettenkofer and Voit,[‡] in feeding animals on flesh from which all fat had been removed completely prove that nitrogenous substances can act as heat-givers as well as flesh-formers. But the converse of the classification is not true, for we have not the slightest evidence to show that alimentary bodies free from nitrogen can build up any organ of the body. It is known that a small quantity of fat is always present in healthy tissue, but it may be wholly removed by ether without injury to the organic structure. The same experiments which proved that flesh-formers might when necessary act vicariously as heat-givers, have also proved that the nutrition of carnivora may be effected without the supply of fat or any other non-nitrogenous body.

2. The chief object of this lecture is to examine the function of nitrogenous ingredients of food, as a magazine of force for the production of dynamical effects in the animal. The consideration of the animal body as a machine, and of the food in the light of fuel supplied to it, has already engaged the attention of philosophers. Rumford,[§] Joule,[‖] Mayer,[¶] Helmholtz,[**] Dumas,[††] Hirn,[‡‡] Fick,[§§] and Carpenter,[‖‖] have published their views on this important subject, but all of them, so far as I know their writings, have looked upon food in its aggregate, applying their calculations to the total carbon and hydrogen contained in it, without discussing the influence exerted by its separate constituents in the production of force.

3. The Rev. Dr. Haughton, of Dublin, has been an exception in this respect. He has endeavoured to find in the urine the representative of the mental, vital, and mechanical work of the human body, and gives the following equations:—[¶¶]

Opus Mechanicum, or 150 lbs. raised one mile . . } $=136{\cdot}5$ grains of urea.
Opus Mentale, or five hours of study. . . . . . } $=217{\cdot}0$,, ,,
Opus Vitale, ... $=297{\cdot}0$,, ,,

He then draws the conclusion that in manual or routine bodily labour, men are sufficiently well fed when they receive as much food as will discharge 400 grains of urea daily (the product of 2·8 oz. of flesh-formers), of which 300 grains are spent in vital work, and 100 grains (the product of less than three-fourths of an ounce of flesh-formers) in mechanical work. But when the work is of a higher order, Haughton states that a better quality of food must be supplied, sufficient to allow a discharge of 533 grains of urea daily, of which 300 grains are spent as before in vital work, and 233 grains in the mental and mechanical work necessary to keep the body in health.

4. If we are to understand these numbers of Haughton as being true exponents of the quantity of tissues necessary to be transformed for the production of force, the latter can readily be calculated and compared with that necessary to effect the work. Urea can only be an exponent of work, inasmuch as it shows us the quantity of tissue which has become oxidised in its production, and thus enables us to express the amount of energy stored up in that tissue, and in the oxygen which transformed it. Now, as 136·5 grains of urea are said to be equal to 150 lbs. weight raised to the height of one mile, we ought to find at least this amount of potential energy in the 405 grains of tissue from which the urea must have been derived, and in the oxygen required to convert it into this diamine. After deducting the hydrogen which may be supposed to have already met with oxygen in the tissues, we have available for transformation—

190·6 grains of carbon.
12·5 ,, hydrogen.
5·1 ,, sulphur.

These numbers, by the usual formula, would give 498·8 lbs. of water raised 1° F., and this, converted into its mechanical equivalent by the co-efficient 772, represents 385,073 lbs. raised to the height of one foot. This, then, represents the total potential energy, while the actual work realised by the man is more than double this amount, or is 792,000 foot-pounds. It is clear, then, that Haughton cannot have meant the equations given by him in the mathematical sense of equality, but only in the

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[*] Animal Chemistry, p. 120.

[†] *Die Gesetze der Ernährung des Fleischfressers*, p. 56, *et seq.*

[‡] *Ann. der Ch. und Pharm. Supp. Bd.*, 1863, p. 361, *et seq.*

[§] Rumford's Essays, vol. ii., p. 488.

[‖] Joule and Scoresby, *Phil. Mag.*, 1846, p. 454.

[¶] Mayer, *Die organische Bewegung in ihrem Zusammenhang mit dem Stoffwechsel*, 1845.

[**] Helmholtz, Lectures at Royal Institution (Lect. vi.), 1864.

[††] Dumas, as quoted by Matteucci, Phy. Phen. of Living Beings, p. 325.

[‡‡] Hirn, Théorie Mécanique de la Chaleur, p. 34.

[§§] Fick's Physiologie des Menschen, p. 291.

[‖‖] Carpenter's *Jour. of Science*, 1864, p. 266.

[¶¶] Haughton on Healthy Urine of Man, p. 32.

general sense of representation. In fact, in a further paper[*] he points out that the combustion of the carbon and hydrogen of the proteine compounds can only account for 54 per cent. (misprinted 34 per cent.) of the work ascribed to the urea. Hence we are obliged to class Haughton with the other writers, who consider that the transformation of the nitrogenous tissues is insufficient to account for the dynamical movements of the body.

5. In discussing this subject anew, I divide the work performed in the body as follows :—

1. Mental work.
2. Calorific work.
3. Internal dynamical work.
4. External " "
5. Digestive or assimilative work.

With the two first divisions we have little to do in the present lecture; with the three last divisions we shall be fully occupied.

6. It will be convenient to proceed in the following order :—

Division I.

A. To ascertain the amount of food necessary for mere subsistence without exercise.

B. To determine the amount of food required for complete health, with a moderate exercise of from five to seven miles daily.

C. To fix the amount of food suited for active work, such as is represented by a man walking twenty miles daily continuously.

D. To find the amount of food consumed by labourers with very arduous occupations, such as navvies engaged on railways.

Having ascertained these preliminary facts, which are altogether independent of theory, we shall then be in a position to proceed to

Division II.

A. To discuss whether there be sufficient potential energy in the nitrogenous tissues, or of the food representing them, and in the oxygen required for their transformation, to account for the dynamical actions within or without the body.

B. To consider whether the fatty and amylaceous or saccharine ingredients of food are employed in this mechanical work.

Having discussed these points, we should then be in a position to proceed to—

Division III.

A. To inquire whether the secretions of urea and uric acid *per vesicam* are sufficient representatives of labour performed.

B. To consider what is represented by the nitrogenous materials secreted *per anum*.

Division I.

Food Required under Different Conditions of Work.

7. In determining the amount of food required for mere subsistence, we ascertain at least approximatively, that necessary for internal dynamical work. By that we mean such work as is carried on within the man independently of the will, and in the direction of which he is an unconscious agent. The heart beats, the blood circulates, the lungs play, the diaphragm acts, the intestines exert their peristaltic motion, by an inner directive movement. In the exercise of these motions a certain amount of force is expended, but it is ultimately converted into heat, and aids the *opus calorificum*, which is chiefly produced by the combustion of the non-nitrogenous parts of food.

In looking for a purely subsisting diet, we naturally turn to the experience of hospitals having convalescent patients unable still to take exercise. The following is the dietetic value in ounces of the "common diet with bread," employed at the Infirmary in Edinburgh.[†]

Flesh-formers	2·06 oz.
Fat	0·58 "
Starch	11·33 "
Starch equivalent of heat-givers	12·69 "
Mineral matter	0·35 "

In this diet the amount of carbon in the flesh-formers is 1·08 oz., and in the heat-givers 5·57, or together, 6·58 oz. This amount of carbon fairly represents that required to keep up the vital actions, for Dr. E. Smith[‡] found, in his own case, that 6 oz. of carbon were exhaled by him during one day's starvation, and Ranke,[§] in a three days' trial, found 6·4 oz. every twenty-four hours. We may therefore assume that 6·5 oz. of carbon are required to support the life of an adult man without exercise. In the following table are some recorded instances of deficient dietaries, although in some of the cases they were only defective because work was expected from the persons living upon them. They are therefore generally sufficient for mere subsistence during rest, but insufficient for the performance of labour.

An examination of the information furnished by this table will justify the conclusion that though 2 oz. of flesh-formers, 0·5 oz. of fat, 12 oz. of starch and sugar, containing a total amount of 6½ oz. of carbon, will suffice for a man to support the internal dynamical motions and other vital necessities of his body when he is at complete rest, they are not compatible with a moderate amount of exercise; so that, even in the condition of low health without activity, 2·5 oz. of flesh-formers, 1 oz. of fat, 12 oz. of starch, and 0.3 oz. of mineral matter are necessary. This diet contains 7·44 oz. of carbon.

Table I.—Subsistence and Low Dietaries.

Flesh-formers	2·33
Fat	0·84
Starch, &c.	11·69
Starch equivalent	13·68
Carbon	7·469

8. We have now to get a mean dietetic value for the food of an adult man in active health, but without hard labour. The dietaries of soldiers during peace offer us a large experience. I have recalculated the following table, which was published formerly by me in a less complete form,[‖] taking bread as containing 37 per cent. of water.[¶]

Table II.—Dietaries of Soldiers during Peace.—Mean of English, French, Prussian, and Austrian Soldiers.

	oz.
Weight of solid food	51·0
Flesh-formers	4·215
Fat	1·847
Starch, sugar, cellulose, etc.	18·690
Starch equivalent of heat-givers	22·059
Mineral matter	0·714
C carbon in flesh-formers	2·267
C' carbon in heat-givers	9·720
Total carbon $C + C'$	11·987
Ratio of $C : C'$ $1 : x$	4·290
Ratio of flesh-formers to starch equivalents, $1 : x$	5·237

The mean of this table may fairly be taken as representing the value of food required to keep adult men in good health. Army Surgeons state that the diet of our own soldiers, which does not differ widely from the mean, is not sufficient for recruits during their drills, though the sergeants fatten upon it. As the average value is also nearly the same as that of middle-class diets,[**] we may

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[*] Haughton on Diabetes Mellitus, p. 30.

[†] The ounce used in this lecture is always 437·5 grains, or 28·35 grammes, the gramme being taken at 15·43 grains.

[‡] Smith, *Trans. Roy. Soc.*, vol. cxlix., p. 681.

[§] Ranke, *Muller's Archiv.*, 1862, s. 342.

[‖] *Good Words*, January, 1865.

[¶] Lawes and Gilbert, *Chem. Soc. Journ.*, x., 54.

[**] *Good Words*, February, 1865.

safely assume it to be a correct expression of the diet of men who live well and take moderate exercise, of from five to seven miles daily.

9. Before we discuss the dietetic value of food required for men engaged in labour, we must define what we understand by a full day's work. We take such work, when performed continuously throughout the year, with rest on Sundays, to be represented by a daily walk of twenty miles. The experience of postmen in rural districts shows that more than this amount of work cannot be executed without breaking down. As the co-efficient of traction is nearly $\frac{1}{20}$th the weight of a man's body, the work which a standard man of 150 lbs. has to perform is 792,000 foot-pounds. That this is a full estimate will be apparent from the following table[††] of the work of a man under different conditions:—

Kind of Labour.	Amount of Work in ft. Tons.	Authority.
Pedestrians	353	Haughton.
Pile-driving	312	Coulomb.
"	352	Lamande.
Turning a winch	374	Coulomb.
Porters carrying goods and returning unloaded	325	"
Porters always loaded . . .	303	"
Porters carrying wood up stairs, descending unloaded . . .	381	"
Paviours at work	352	Haughton.
Prisoners at shot drill . . .	310	"

Mean, 340·2 tons = 105,605 metre kilogrammes.

The mean of this table gives 762,048 foot-pounds. A man's labour differs within a tolerably wide range, according to the manner in which it is exerted, for while it may not exceed 480,000 foot-pounds in hammering, it may reach to 1,500,000 foot-pounds when pushing or pulling horizontally.[‡‡] Hence the amount of 792,000 foot-pounds taken for a day's work, may be considered a full, though not an excessive amount.

This estimate receives further support when we examine the work performed by soldiers in war. In Sherman's famous march from Atlanta to Savannah, twelve miles daily were accomplished. In war, the Prussian army walks fourteen miles daily, resting every fourth day. In our Indian marches, twelve miles daily, with the same rest, is the work allowed to the troops. Hence, if we take full war work as represented fourteen miles' daily continuous marching, the soldiers being laden with 60 lbs. weight of accoutrements,[§§] we have a full estimate of labour work. This is found by the following equation:—

$$\left[\frac{150+60}{20}\right] \times 73920 = 776160 \text{ foot-pounds.}$$

The weight of the man and of his accoutrements, divided by the co-efficient of traction, and multiplied by the number of feet traversed, thus leads us to a result rather less than that found for the pedestrian. The following table gives the dietetic value for soldiers engaged in the arduous duties of war:—

Table III.—Dietaries of Soldiers during War.—Mean of European and American Diets during recent Wars.

	oz.
Weight of solid food	46·0
Flesh-formers	5·41
Fat	2·41
Starch, sugar, &c.	17·92
Starch equivalent	23·48
Mineral matter.	0·68
C Carbon in flesh-formers	2·90
C′ Carbon in heat-givers	9·81
Total carbon, C+C′.	12·71
Ratio C : C′ :: 1 x.	3·37
Ratio of flesh-formers to starch equivalent .	4·35

Hence it will be observed that about 5·5 oz. of flesh-formers, and 23½ oz. of the starch equivalent of heat-givers, are required by the soldier to enable him to withstand the fatigues of war.

10. We possess in the English army a corps of soldiers who are labourers even during peace. I allude to the Royal Engineers, who, while in the depôt at Chatham, are actively occupied either in constructing field works, or in pursuing their avocations as artisans, from which class they are all selected. Desirous to obtain the dietaries of these men, I applied to Colonel Collinson, R.E., the second in command at Chatham, and he, with the consent of Colonel Harness, instituted a careful inquiry into the actual amount of food consumed by 495 men for twelve consecutive days. Quartermaster Conolly took an active part in the inquiry, and the captains of each of the companies became responsible for the accuracy of the returns, which were made with all the detail and care to be expected from this highly scientific corps. These returns were then reduced to their dietetic value by myself, so that we may consider them as affording the most complete evidence which we possess of the requirements of food for labouring men during a fair but not an excessive amount of work in twenty-four hours.

Table IV.—Dietaries of the Royal Engineers from 1st to 12th January, 1865.

		Mean of all returns.
Number of men giving returns		495
Weight of solid foot	oz.	66·97
Flesh-formers	"	5·08
Fat	"	2·91
Starch, sugar, etc.	"	22·22
Starch equivalent	"	29·38
Mineral matter	"	0·93
C carbon in flesh-formers	"	2·730
C′ carbon in heat-givers	"	12·113
Total carbon, C+C′.	"	14·844
Ratio C : C′ : : 1 x.	"	4·45
Ratio of flesh-formers to starch equivalent	"	5·82

There are several points of interest shown by these reductions. The working soldier finds it necessary to take about five oz. of flesh-formers daily. The only notable exception is in the case of a detachment of the 38th Company, stationed at the South Kensington Museum. This exception furnishes a ready explanation, for although these soldiers are even better paid than those at Chatham, their work is of a less laborious character, being chiefly that of draughtsmen, photographers, etc.; with this work they do not require a larger quantity of flesh-formers than is consumed by soldiers of the line, and accordingly we find that their diet sinks to this level.[‖‖] Omitting this exceptional case, we find a singular uniformity in the starch equivalent of heat-givers. It is higher than that of soldiers engaged in war, but this is doubtless due to the ease with which potatoes are obtained in garrison, and to their being always in considerable quantity in the diet.

11. We do not possess many well-recorded instances of labourers' diets by actual weight and measure. The approximative returns obtained by Dr. E. Smith, in his report to the Privy Council on the diet of the working classes, are valuable for what they profess to be, as giving us an insight into the mode of living of artisans; but they can scarcely be considered as presenting us with data of weight and measure, ascertained with any further degree of precision than could be obtained by conversation with working people. I append a few instances of working dietaries, which have been determined by actual weights of the food consumed.

[††] Haughton on a New Theory of Muscular Action, p. 16.
[‡‡] Rankine, "Applied Mechanics," p. 610.
[§§] Parkes, "Hygiene, p. 369.

[‖‖] For this return I am indebted to Captain Donelly, R.E., Inspector of Science to the Department of Science and Art.

Table V.—Examples of Labourers' Dietaries.

Class of Labourer.	Flesh-formers	Fat.	Starch, sugar, &c.	Starch equivalent.	Carbon.
English sailor (fresh meat)¶¶. . . .	5·00	2·57	14·39	20·40	11·05
French sailor* . . .	5·74	1·32	23·60	26·70	14·58
English navvy (Crimea)† .	5·73	3·27	13·21	21·06	11·46
„ „ (Rouen Railway)‡	6·84	3·82	27·81	37·08	18·96
Hard-worked weavers§ .	5·33	1·53	21·89	25·42	13·76
Fully-fed tailors‖ . .	4·63	1·37	18·47	21·64	11·74
Blacksmiths¶ . . .	6·20	2·50	23·50	29·50	15·69
Mean working diet . .	5·64	2·34	20·41	25·97	13·89

I have not quoted in this table the well-known allowances of 910 lbs. oatmeal given annually to our Scotch agricultural labourers on the bothy system, and 60 oz. of milk daily. This diet equals 8¾ oz. of flesh-formers, 4·5 oz. of fat, and nearly 27½ oz. starch. I attach little importance to this, because it is well known that the labourer sells nearly a quarter of the oatmeal to buy spirits and other luxuries. A man training for prize-fighting,** and who walked seventeen miles daily for exercise, was found to eat weekly 269 oz. of mutton, without bones, 14 oz. of bread (only 2 oz. daily at dinner), and 170 oz. of ale. The food of this prize-fighter had therefore the following dietetic value:—

Flesh-formers	9·8 oz.
Fat	3·1 „
Starch	3·27 „
Starch equivalent. . . .	10·70 „

This result, however, is certainly not an average case, although interesting as showing the conditions employed in training a man to the extreme of muscular activity.

13. From the preceding data we propose to take the following general averages in our calculations:—

	Subsistence Diet.	Diet in Quietude.	Diet of Adult in full Health.	Diet of Active Labourers.	Diet of Hard-worked Labourers.
	oz.	oz.	oz.	oz.	oz.
Flesh-formers .	2·0	2·5	4·2	5·5	6·5
Fat . . .	0·5	1·0	1·8	2·5	2·5
Starch . .	12·0	12·0	18·7	20·0	20·0
Starch equivalent	13·2	14·4	22·0	26·0	26·0
Carbon . .	6·7	7·4	11·9	13·7	14·3

(To be continued.)

ACADEMY OF SCIENCES.

May 1, 1865.

M. Seguier made some further remarks "*On Improvements in Firearms,*" and showed an experiment which illustrated the effects of a sudden application of force on glass. (This experiment is described by our Paris correspondent.)

M. Boussingault read a memoir "*On the Functions of Leaves.*" The author has made some further experiments on the absorption and assimilation of carbonic acid by leaves exposed to sunlight. His results are thus summed up:—1. Leaves exposed to the sun in *pure* carbonic acid do not decompose this gas, or if they do, it is with excessive slowness. 2. Leaves exposed in a mixture of carbonic acid and atmospheric air rapidly decompose the former gas. Oxygen does not seem to interfere in the phenomenon. 3. Carbonic acid is rapidly decomposed by leaves when that gas is mixed with either hydrogen or nitrogen. The author points out some analogies of these phenomena with the slow combustion of phosphorus under certain circumstances. Thus phosphorus placed in *pure* oxygen does not become luminous and does not burn, or if it does, burns with excessive slowness. In a mixture of oxygen and atmospheric air, however, phosphorus burns rapidly. Further, phosphorus placed in a mixture of oxygen with hydrogen, nitrogen, or carbonic acid burns and emits light. M. Boussingault mentioned also that phosphorus which does not burn in pure oxygen at an ordinary pressure, becomes combustible when the gas is rarefied, and he showed that similarly a leaf placed in pure and rarified carbonic acid decomposed the gas and evolved oxygen.

M. Pelouze read a memoir "*On the Volumetric Determination of Iron in the Blood.*" The author takes a given weight of blood, dries it carefully, incinerates the residue, dissolves the ash in hydrochloric acid, and then estimates the iron by Margueritte's process. He gives a table of the amount of iron in 100 grammes of the blood of various animals, and states by way of summary that, if he is not deceived, there is in 1000 parts of the blood of birds from 3 to 4 parts of iron, and in the blood of mammals from 5 to 6 parts.

M. H. St. Claire Deville presented a memoir "*On the Phenomena of Dissociation in Homogeneous Flames.*" It related to the chemical composition and the distribution of heat in a flame produced by a mixture of oxygen and hydrogen, or carbonic oxide and oxygen burnt from an oxyhydrogen blow-pipe. The author in this paper describes the results with carbonic oxide and oxygen, mixed in the proportions to form carbonic acid. The flame is seen to be composed of an outer and inner cone; the latter composed of the uncombined gases, the former of the gases in combustion. The interior cone had a height of about 10 millimetres, while the more visible part of the exterior cone rose to 70 or 100 millimetres. We may, on a future occasion, translate the description given by the author of the means which he used to withdraw the gases from different parts of the jet of flames, and also a table showing the temperature and the composition of the gas at various heights; to-day we must content ourselves with the following summary. The observations show,—

1. That the temperature goes on increasing from the lower part of the flame up to the summit of the interior cone.

2. That the proportion of uncombined gases (oxygen and carbonic oxide) to the combined gas (carbonic acid) increases from the upper part of the dart of flame, where carbonic acid alone was found, down to the lower part (summit of interior cone) where only two-thirds of the oxygen and carbonic oxide had united.

M. de Vergnette-Lamotte made a communication "*On the Effects of Heat in the Preservation and Improvement of Wines.*" Burgundy is much improved by a voyage to and from Calcutta. This fact led the author to try the effects of warmth on wines at home, and both he and M. Pasteur have come to the conclusion that wines may be much improved by gently warming them, and that sick wines may be cured by the same means. M. Pasteur has, in fact, taken out a patent for warming wines by placing the bottles in a hot-air stove with the corks tied down to prevent their being forced out by the expansion. The bottles must be quite full, and have no air in them, and are heated to 64° C. for half-an-hour, after which the cork is untied, driven home, and sealed down. In the process just described of course all parasitic ferments are destroyed, and the wines keep well after it.

Admiral Berigny presented a memoir entitled "*A Resumé of Ozonometric Observations for Nine Years.*" The experiments were made at Versailles, and the results arrived agree exactly with those M. Houzeau observed at Rouen. (See *ante*, p. 201.) The maximum of ozone is observed in May, the minimum in November and February. M.

¶¶ Advantages of Entering British Navy. Bradbury and Evans, 1854.

* Payen, Substances Alimentaries, p. 322.

† Dietary to Navvies Employed in Making the Railroad in the Crimea (Letheby), *Soc. Arts Journ.*, 1863.

‡ Gasparin, Cours d'Agriculture.

§ Dr. E. Smith, *Phil. Trans.*, vol. 151, p. 747, *et seq.*

‖ *Idem.*

¶ Food consumed by a blacksmith; mean of two days.

** Percy on Fæces.

Deville remarked the coincidence of the phenomena with the passage of asteroids. M. Elie de Beamont remarked the coincidence of the maximum of ozone with the maximum activity of vegetable synthesis, while the minimum coincided with the maximum activity of vegetable decomposition. Surrounded by forests, the town of Versailles is well placed for observing this double influence.

M. Hugo Schiff presented a note "*On Some Amides of the Toluic Series*," obtained by the action of various aldehydes upon toluidine and tolulylendiamine.

M. Pisani described a mineral found under a dead tree at Chypis, and composed of bicarbonate of potash, which the author proposes to call *Kalicine*.

M. V. de Luynes gave a continuation of his "*Researches on Orcine*." The author described diacetic, dibutyric, and dibenzoic orcine. It results from the author's researches that orcine is found to behave towards acids and bases like phenic acid; but while phenic acid in contact with acid chlorides only exchanges one equivalent of hydrogen for one equivalent of the chloride of the radical, orcine, under the same circumstances, exchanges two of hydrogen for two of the chloride. Hence, if phenic acid be considered a monatomic phenol, orcine must be classed among the diatomic phenols. By its formula orcine is the homologue of oxyphenic acid, $C_{12}H_6O_4$, which gives with acid chlorides biacid compounds; it is derived from oxysalicylic acid in the same way as phenol from salicylic acid. Oxyphenic acid, then, is the diatomic phenol corresponding to phenic acid. So orcine is the diatomic phenol corresponding to the monatomic phenol $C_{14}H_8O_2$, identical or isomeric with cresylic phenol as shown here :—

$$\text{Phenol, } \left.\begin{matrix} C_{12}H_5 \\ H \end{matrix}\right\} O_2 \qquad \text{Oxyphenic acid, } \left.\begin{matrix} C_{12}H_4 \\ H_2 \end{matrix}\right\} O_4$$

$$\text{Phenol(?)} \left.\begin{matrix} C_{14}H_7 \\ H \end{matrix}\right\} O_2 \qquad \text{Orcine, } \left.\begin{matrix} C_{14}H_6 \\ H_2 \end{matrix}\right\} O_4$$

An attentive study of these phenols may show in what way their synthesis must be attempted.

M. Harnitz-Harnitzky communicated "*A General Method of Synthesis of Volatile Fatty Acids*." Mitscherlich showed that acids of the fatty and aromatic series, under the influence of caustic alkalies, and at a high temperature, split up into carbonic acid and carbides of hydrogen containing an atom of carbon less, and as much hydrogen as the acids employed. He therefore regarded these bodies as carbonates of carbides of hydrogen. Last year the author fixed carbonic acid on benzine, and so obtained benzoic acid. He has now added carbonic acid to marsh gas, and formed acetic acid, and also to hydride of amyl, and so formed caproic acid. He makes use of oxychloride of carbon as the source of carbonic acid. Oxychloride of carbon and marsh gas brought together in a retort heated to 120° combine to give chloride of acetyl and hydrochloric acid. The former, on the addition of water, furnishes acetic and hydrochloric acids. In the same way hydride of amyl and oxychloride of carbon furnish hydrochloric acid and chloride of caproyl. The substance which condenses in the receiver is an oily liquid which the author rectifies, and taking the part which distils between 115° and 140°, treats it with absolute alcohol, so as to obtain caproate of ethyl. Another distillation, collecting between 161° and 163° gives a liquid lighter than water, possessing the aromatic odour of caproic ether. In both cases the author confirmed his results by analyses.

M. C. Friedel communicated "*A New Method of Producing Acetone by Synthesis*." The author started with *chloracetene* (a body first obtained by Harnitzky by the action of oxychloride of carbon on aldehyd), and added this to methylate of sodium, whereby chloride of sodium and acetone were formed.

$$\underbrace{C_3H_5Cl}_{\text{Chloracetene.}} + \underbrace{CH_3NaO}_{\substack{\text{Methylate} \\ \text{of sodium.}}} = NaCl + \underbrace{C_3H_6O.}_{\text{Acetone.}}$$

M. Persoz presented a note "*On the Decomposition of Ammonic Nitrate by Heat*." M. Pelouze objected to the author's former experiment (see *ante*, p. 166) that nitrate of ammonia is volatilised by heat, and its decomposition might furnish the nitric acid found with the potash lime. M. Persoz has, therefore, experimented further, and finds that the nitrate distils, and is, moreover, decomposed in the process, for it condenses along with a strongly acid liquid. By repeating his former experiment, however, with a plug of moist cotton in the neck of the retort to arrest any nitrate of ammonia or other condensible product, he obtained the same results as before—potassic nitrate and ammonia. Persoz admits the truth of Pelouze's statement that when the protoxide of nitrogen is washed with dilute sulphuric acid no ammonia is obtained, but only nitric acid.

NOTICES OF BOOKS.

Bulletin Mensuel de la Société Chimique de Paris, &c. April, 1865.

We transcribe the titles of the papers read before the Chemical Society of Paris, which have not already been noticed in our reports of the Academy of Sciences. "On hydriodate of bromated ethylene, and on its decomposition by hydrated oxide of silver and acetate of silver," by Pfaundler. "On diamido-salicylic acid, and its combinations with acids," by Saytzeff. "On the action of bromine on isopropylic alcohol, and on iodide of isopropyl," by Friedel. "Researches on the nitrated naphthalines, and bases derived from them," by A. d'Aguiar. "Facts relating to the chemical metamorphoses of santonine," by Sestini. And "On the absorption of iodine by urine and other animal fluids," by Terreil. In this last paper the author shows, in reply to Schönbein, that urate of ammonia is the substance which effects the absorption of urine in animal fluids, and he employs iodine to determine the amount of urate, calculating that one equivalent of each body unites in the reaction. He uses the iodine in a standard alcoholic solution, containing 12·86 grammes in the litre.

Chemisches Central-Blatt. No. 13.

Number 13 contains several papers on organic chemistry, which have already received notice in our pages. Some short paragraphs "*On the Reciprocal Hygroscopicity of Chloride of Calcium and Sulphuric Acid*," "*On the Use of Aniline Colours in Oil and Aquarelle Painting*, and "*On a Means of Combining Aniline Red with Oils and Fats*," will be found among our "Miscellanea."

Number 14 contains the conclusion of an article by Arppe, "*On some Products of the Oxidation of Fat*," In the former paper the author described sebacic and azelaic acids and some of their salts. He now describes suberic, pimelic, adipic, lipic, nitrocapric, and nitrocaprylic acids. The rest of the papers have been noticed in connection with other journals.

All the articles in Numbers 15 and 16 are abstracts of articles on advanced organic chemistry, and would have no interest for the great bulk of our readers.

Number 17 contains an original article by Bunge "*On the Action of Sodium Amalgam on some Metallic Salts*." A tolerable strong aqueous solution of ferric chloride, acidulated with hydrochloric acid, when treated with sodium amalgam becomes clearer and clearer, and at last colourless, the whole of the iron being reduced to protoxide. By the further action of the amalgam all the iron is withdrawn from the fluid, and is found as iron amalgam. The author is of opinion that the reduction of ferric to ferrous chloride, and of the latter to metallic iron, proceeds simultaneously.

Chromic chloride suspended in acidulated water undergoes a similar reduction. The amalgam of chromium was fluid, and rather unstable. On standing its surface became covered with a dark grey powder of metallic chromium.

Mercuric and gold chlorides are similarly reduced. In the former case calomel is first produced.

The chloride, iodide, and bromide of silver are very quickly reduced. (The author made all these experiments in the dark.) This reaction, it is thought, may be usefully applied in the analysis of the haloid compounds of silver, instead of fusing these compounds off with an alkaline carbonate. It is only necessary to place a small quantity of the powder in a test glass with a little water, and add thereto some pieces of sodium amalgam, and the chlorine, iodine, or bromine may be detected in the solution in the ordinary way.

The next paper is the first part of an abstract of Stas' report "*On the Commercial Methods of Extracting the Fatty Acids.*" The original paper, our readers know, is of great interest.

"*A Contribution to the Chemistry of Clays,*" by E. von Sommaruga, follows. The author is analyst to the Vienna porcelain works, and gives here several analyses of German clays and felspars with special instructions respecting their use in the manufacture of porcelain.

Zeitschrift für Chemie, &c. Nos. 5 and 6, 1865.

This journal in all but the form now resembles the *Central-Blatt.* In No. 5 we find no original communication; No. 6 contains one, "*A Preliminary Notice of Cytisin and Laburnin,*" two new bases found in *Cytisus Laburnum* by Huseman and Marmé. Cytisin is a strongly poisonous alkaloid, which the authors have extracted from the ripe seeds of the laburnum, and have also been found in three other species of the family Cytisus. To obtain the alkaloid the authors precipitated a decoction of the seeds with acetate of lead, concentrated the filtrate, and precipitated with tannic acid. This precipitate was decomposed by digesting and evaporating to dryness with oxide of lead, and from the dry mass alcohol extracted the alkaloid. Pure cytisin forms a colourless crystalline mass; is strongly alkaline; sublimes undecomposed, and quickly liquefies in the air. The nitrate crystallises well, and the alkaloid was purified by converting it into this salt, evaporating the solution with oxide of lead, and extracting with absolute alcohol.

Laburnin is a weakly basic poisonous body, which the authors procured from the unripe seeds and pods of the laburnum. It is obtained by a process similar to the above, but in place of tannic acid, phosphomolybdate of soda was used to precipitate the alkaloid, and the precipitate was decomposed by boiling to dryness with chalk; absolute alcohol extracted laburnin from the dry residue. The authors promise further communications on these bodies.

Journal für Praktische Chemie. No. 2, 1865.

This journal opens with a long paper by Hlasiwetz, and Pfaundler "*On Morin, Maclurin, and Quercitrin.*" The account of these vegetable principles and their derivatives in this and former papers by the same authors is very complete.

In a short chemical notice by F. Stolba, of Prague, he announces the detection of *copper in beer*, a likely thing to find in all beers. The process recommended by the author for detecting the metal is as follows:—He dips a strip of filter paper in the beer and dries it, and repeats this operation four or five times. He then wraps the paper round a piece of iron wire and ignites it. The ash so obtained he mixes with a very small quantity of pure sal ammoniac and water to form a thick paste, and on the end of the wire introduces it to the outer flame of a spirit lamp. The least trace of copper colours the flame blue. The analyser must of course assure himself that neither the paper nor the sal ammoniac contains copper, and must not use a brass lamp.

The same author gives a "*Contribution to the Knowledge of Lead.*" He first shows that the red-coloured lead supposed by Wöhler to be an allotropic condition of the metal, is only lead covered with an exceedingly thin layer of some foreign matter, probably oxide. The author has made numerous experiments "*On the Action of Pure Water on Lead,*" and states that when pure distilled water is boiled with a somewhat large quantity of foil or granulated lead, a very appreciable amount of hydrogen is evolved. The conditions under which this experiment can be made will be apparent to our readers. In ten minutes two cubic centimetres of hydrogen were obtained. The fluid remaining in the flask was strongly alkaline, and cloudy with lead oxide.

In text-books it is said that lead is but slightly attacked by hydrochloric acid, and only when heated. Stolba, however, states that hydrogen is evolved from the mixture at the ordinary temperature, and on the application of heat the action becomes energetic when finely granulated lead is employed. By contact with copper the evolution of hydrogen is greatly increased. The author notices that the action of hydrochloric acid is strongest at first, and gradually becomes weaker in consequence of the metal becoming coated with a layer of chloride.

Dr. C. Rube, of Freiburg, communicates "*A Method of Estimating Magnesia and the Alkalies.*" He takes the mixed sulphates, and after ignition and weighing dissolves them in a small quantity of water, and then first precipitates the potash with chloride of platinum. He then removes the excess of platinum from the filtrate by sal ammoniac, and afterwards precipitates the magnesia from this filtrate by phosphate of soda. After standing some hours, the solution filters easily, and the magnesian precipitate can be collected and weighed. The soda is obtained by difference.

Among the short notices we only find one which has not already appeared in our pages, and that one, "*On a Yellow Colouring Matter from Rosaniline,*" will be found in another place.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

538. P. A. le Comte de Fontaine Moreau, Rue de la Fidélité, Paris, "Certain improvements in the treatment of madder and the products obtained therefrom."—A communication from J. Pernod, Avignon, France.—Petition recorded Feb. 25, 1865.

872. W. Walsh, Warrington, "Improvements in apparatus employed in the concentration of all solutions where quick or speedy concentration or evaporation is required."—March 28, 1865.

942. H. Brook, J. Eastwood, and G. Brook, Huddersfield, "Improvements in apparatus applicable to furnaces for smelting ores and melting metals."—April 3, 1865.

1068. W. Clark, Chancery Lane, "Improvements in the manufacture of a compound or material to be used as a substitute for india-rubber."—A communication from H. Loewnberg, New York, and E. Grainer, Paris.—April 15, 1865.

1075. J. Dougan, Coed Ta'on, near Mold, North Wales, "Improvements in apparatus for distilling hydrocarbons from coal, schists, and other minerals."—April 17, 1865.

1088. R. A. Jones and Joseph Hedges, Aylesbury, "Improvements in, and apparatus for, communicating intelligence by means of electricity."—April 19, 1865.

1149. N. Sibly, St. Laurence, near Bodmin, Cornwall, "Improved apparatus for pouring and decanting liquids."

1153. J. N. Brown, Handsworth, and T. D. Clare, Birmingham, "Improvements in the manufacture of iron, and in preparing fuel to be used in the manufacture and melting of iron."

1159. J. C. Wickham and A. E. Deiss, Bow, "Improvements in the manufacture of waterproof fabrics, and in apparatus to be employed therein."—April 25, 1865.

Notices to Proceed.

3192. J. Bethell, King William Street, London, "Improvements in preserving wood."—Petition recorded Dec. 23, 1864.

3214. H. Hicklin, Wollaston, near Stourbridge, and C. Pardoe, Brierly Hill, "Improvements in the construction of coke ovens."—Dec. 27, 1864.

3242. B. Baugh, Balsall Heath, "New or improved machinery to be used in the manufacture of enamelled wares."—Dec. 29, 1864.

596. W. R. Bowditch, Wakefield, "An improvement in carburetting gas, and improved methods of treating alkali which has been used to purify coal oils, shale oils, petroleum, and other mineral oils."—March 3, 1865.

CORRESPONDENCE.

Continental Science.

Paris, May 9.

A new hygrometer has recently been invented, which, it is said, gives very correct indications. It consists of a thin circular slice of ivory sawn into a spiral, which being extended, by its contractions and expansions gives motion to an arm. I doubt whether this apparatus is more sensitive than the old twisted catgut form of weather indicator.

M. Pelon's "heat generator," which I mentioned last week, is in actual use at the Central Pharmacie, and seems to be really efficacious. The machine is turned by a force equal only to about the twentieth of a horse-power, but after rotating for about eight or ten minutes the air escaping from the apparatus was found to have attained a temperature of 70° C. An apparatus of a similar size, moved by the same force, it is said, will, in the coldest winter, keep a railway-carriage at a constant temperature of 22° to 25° C., which will be a great comfort to the passengers.

On the 21st of last month the Photographic Society of Paris awarded four gold medals. One of these was allotted to Sir David Brewster for the invention of his stereoscope. The Abbé Moigno wonders why the Society did not go back further, and give a medal to Professor Wheatstone for his stereoscope.

The recent edict of the Minister of Agriculture and Commerce, ordering manufacturers using steam power to consume their smoke, has excited much opposition. There are plenty of inventions here as well as in London for effecting this purpose, but they do not seem to answer any better here than with you. The Industrial Society of Mulhouse have sent a petition to the Minister, asking for a suspension of the edict for six months, that the question may be seriously studied. They say that none of the inventions yet brought out are satisfactory in practice. They either necessitate an increased consumption of coal or they require greater attention on the part of the stoker than can possibly be given in actual practice. The inventors, of course, deny the truth of these assertions, and thus the matter at present remains. There would seem to be a field for Mr. Juckes, whose apparatus I have seen to answer perfectly in London, and to require very little attention by the stoker.

I mentioned M. Seguier's new cartridge last week, and, writing in a hurry, did not, I am afraid, give a very clear account of his ideas. I should have said that the best application of the force which is produced by the conversion of solid into gaseous matter is made when that force is, so to speak, generated *crescendo*. This the Baron effects by first igniting a slow burning powder, which starts the ball, and firing afterwards a charge of gun-cotton, which gives a tremendous impulse, thus imitating the action of an air-gun. The Emperor has taken great interest in the Baron's experiments and invention. Emperors usually do take great interest in destructive arts. The Baron appeared again at the last meeting of the Academy, and exhibited a curious and very interesting experiment.

Your readers will remember Faraday's old experiment of smashing a glass vial by breaking a Prince Rupert's drop within it immersed in water. The experiment of Baron Sequier is of a similar kind, and illustrates the same fact —namely, the incompressibility of water. He took a glass tube, and suspended it vertically in a vessel of water. He then let a leaden bullet fall through the tube, the effect of which was to split the tube into longitudinal fragments, like the staves of a barrel. When only a part of the tube is immersed, the effect is more curious still. That part not immersed remains entire, but the tube is cut off at the level of the water, and the part under the water is split, as before mentioned. Any of your readers can make these experiments for themselves.

General Morin made some remarks on this subject, and mentioned some experiments made several years ago, in which solid and hollow shot were fired into water horizontally below and parallel to the surface of the water. The resistance of the water was found to be so great that the shells were in all cases broken to pieces. The earthwork of the tank, four metres thick, was always strongly shaken, and the experimenters felt the ground tremble under their feet.

MISCELLANEOUS.

The Royal Society's Soiree.—As President of the Royal Society, Major-General Sabine held his second reception on Saturday evening last, 6th inst., at Burlington House. Although the assembly was not graced by the presence of royalty, as on the former occasion, there was a full attendance of visitors, and a very numerous and interesting collection of objects exhibited. The fine arts were well represented by some choice original drawings by Corregio and other old masters from the Queen's collection; by the paintings of Mr. M'Callum and M. Van Haanen; and by the sculpture and wood-carvings of Messrs. Durham, Munro, Boehm, Woolner, and Rogers. Mr. Joubert sent some of his best photo-enamels, and M. Claudet, Messrs. M'Lean and Haes, and Mr. Swan, some excellent examples of photography, each in their particular and characteristic style. Among the scientific instruments were shown Dr. Sprengel's air-pump, and a very delicate thermo-electric apparatus, for showing the development of heat during the growth of plants, by Messrs. Elliott, Brothers. Mr. Gassiot's new rigid spectroscope, wherein the prisms are made to perform double work, and all the essential parts are mounted permanently. Mr. J. Browning showed some novel and very pretty effects suggestive of the kaleidoscope by means of a new revolving spectroscope with perforated diaphragms and prisms kept in rotation; other spectrum instruments for adaptation to the microscope and for a variety of particular applications were likewise exhibited by Mr. Browning. Messrs. C. and F. Darker exhibited some of the beautiful polarising objects for which their house has long been celebrated; amongst these a bunch of grapes and attached vine leaves was remarkable for the care bestowed in its production. The magnificent series of iron and steel specimens shown under the microscope by the aid of Mr. Sorby's special illuminator, appeared to excite much interest, as also a large block of meteoric iron with accompanying photographic representation of the etched surface, sent by Professor Abel. A very fine specimen of the new mineral, langite, was shown by Mr. J. R. Gregory; and Messrs. Johnson and Matthey sent some splendid illustrations of the platinum, gold, and magnesium manufactures. The Society's meeting-room was throughout the evening subjected to alternate illumination by the magnesium light, and by flashes from Captain Colomb's signaling apparatus.

Metalliferous Mines Bill.—In the House of Commons on Monday last, Mr. Kinnaird asked the Secretary of State for the Home Department what steps he had taken, or proposed to take, to remedy the very serious evils which had been brought to light by the evidence taken by the Royal Commission appointed to inquire into the condition of mines, and which reported last session. Sir G. Grey said that the course which had been taken with respect to the report was this:—It had been thought right to confer with the members of that Commission, several of whom were members of the House, on the subject. On many of the points raised in the report it did not appear possible that any legislation could take place, but there were other points on which it might be expedient to legislate, and he had accordingly called a meeting at the Home Office, when that matter was fully gone into; and it was decided by a majority of the members of that Commission that with a view to the accomplishment of the object in question it was inexpedient that any hasty legislation should take place. It was necessary that the recommendation of the Commissioners, with respect to the county of Cornwall especially, should be more thoroughly discussed and the opinions of persons interested in mines in the locality should be obtained. That opinion, however, was not shared by his noble friend at the head of the Commission, who had proposed to introduce a bill with a distinct object, but for the reasons he had stated the Government did not think it desirable to introduce any bill during the present session.

Magnesium.—Mr. J. N. Hearder, of Plymouth, in experimenting with this new metal has discovered some explosive compounds of tremendous power and striking peculiarities. He ignited a small portion (about twenty grains) of one of these compounds during a lecture which he gave at the Plymouth Mechanics' Institute, the instantaneous and dazzling effect of which upon the audience was like that of a flash of lightning, causing the room to appear for some seconds afterwards to be enveloped in darkness, though it was at the time brilliantly lighted with gas. On causing two bars of magnesium to form the terminals of a powerful voltaic battery, which was prepared to exhibit the electric light, a most intense combustion ensued, one of the bars speedily became red-hot, entered into ebullition, and then burnt spontaneously so furiously that it became necessary to plunge it into water to prevent its falling on the platform. In this process portions of the burning metal detached themselves, and floated blazing on the surface of the water, decomposing it after the manner of potassium, and liberating hydrogen, which also burned. The experiment had never been tried before, and the result possesses much scientific interest.—*Mining Journal.*

Royal Institution of Great Britain.—General monthly meeting, Monday, May 8, 1865; Sir Henry Holland, Bart., M.D., D.C.L., F.R.S., President, in the chair. The President appointed the following Vice-Presidents for the ensuing year:—The Lord Wensleydale, the Earl Percy, Sir R. J. Murchison, and Wm. Pole, Esq. Charles Butler, Esq., William Henty, Esq., Walter Morrison, Esq., M.P., George Banks Rennie, Esq., Arthur Charles Tanqueray, Esq., and Philip D. Tuckett, Esq., F.G.S., were elected members of the Royal Institution. The following Professors were re-elected:—William Thomas Brande, Esq., D.C.L., F.R.S., Hon. Professor of Chemistry; John Tyndall, Esq., Ph.D., F.R.S., Professor of Natural Philosophy; Edward Frankland, Esq., Ph.D., F.R.S., Professor of Chemistry. The special thanks of the members were returned for the following additions to "The Donation Fund for the Promotion of Experimental Researches:"—John Carrick Moore, Esq. (2nd annual donation), 10*l.*; Harry Mackenzie, Esq. (2nd donation), 20*l.* The presents received since the last meeting were laid on the table, and the thanks of the members returned for the same. The following are the arrangements for the ensuing week:—Tuesday, May 16, at 4 o'clock, Prof. Frankland, "On Organic Chemistry." Thursday, May 18, at 4 o'clock, Prof. Frankland, "On Organic Chemistry." Friday, May 19, at 8 o'clock, Wm. Huggins, Esq., "On Stellar Physics and Chemistry." Saturday, May 20, at 4 o'clock, Alexander S. Herschel, Esq., "On Meteorology."

Silicate of Methyl and Silicium Methyl.—Friedel and Crafts have announced to the Paris Chemical Society that they have succeeded in forming silicate of methyl by the action of perfectly pure and dry wood spirit on chloride of silicium. By heating together zinc methyl and chloride of silicium they obtained silicium methyl.

Action of Petroleum on the Human System.—Landerer relates the case of a man who swallowed a quantity of petroleum, the greater part he vomited again. It caused a strong burning sensation in the tongue and throat, which were reddened and became swollen. The stomach and bowels were also affected, and slight gastro-enteritis ensued. For several days the urine and sweat smelt strongly of the oils, and the odour was specially strong under the arm-pits. The patient was very weak for a time, but recovered.—*Chem. Central Blatt.*

How to Combine Fat and Oil with Aniline Red.—Dr. E. Jacobsen gives the following process:—He first separates rosaniline from commercial fuchsine by heating with soda or digestion with ammonia, washes and dries it. He then adds the rosaniline to oleic acid or melted stearic acid as long as it will dissolve, or puts them together in equivalent proportions. An excess of oleic acid must be avoided when the compound is required for a varnish, as it delays the drying. Oleate or stearate of rosaniline easily dissolves in fats or oils, and colours these an intense red. If it is wanted for a linseed oil varnish, the linseed oil must be free from lead. The compound must be kept from the fire, or it soon burns blue, probably by the reducing action of the fatty acids. The best red colour is obtained in linseed oil varnish. Stearin with oleate or stearate of rosaniline appears a bluish red. Paraffin appears to act as a reducing agent with the compounds of fatty acids and aniline, and changes to a dirty violet colour; the mixture then is inapplicable to the colouring of paraffin or stearine candles. The oleate or stearate of rosaniline is a good colouring agent for hair oil or pomatum, but from the instability of the colour seems inapplicable for oil painting or varnishes.—*Dingler's Polytech. Journ.*, Bd. 174, s. 405.

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. *Private* letters for the Editor must be so marked.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Q. Q. (or 99.)—Received, with thanks. The writer's industry is commendable, and his acuteness remarkable. He may be assisted out of the last difficulty by remembering that in this formula O=100.

Books Received.—"A Letter to the Members of the British Medical Association," &c., by R. B. Carter, F.R.C.S.; "Notes on Chemistry," &c., by Dr. Bernays.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Influence of Ozone and some other Chemical Agents on Germination and Vegetation, by M. Carey Lea, *Philadelphia.*

At no time has the subject of the influences of chemical agents on plants received so much intelligent attention as at present, and the labours of Boussingault, Knop, Stohmann, Ville, Sachs, and many others are daily adding to our stock of knowledge and developing new and interesting facts. The studies of these chemists have, however, been directed almost entirely to the effects of the absence or presence in greater or less proportion in the soil of those bases and acids which are there commonly found. With respect to other agencies, little has been done since the valuable investigations of Turner and Christison, made more than thirty years ago, in which they examined the effects of chlorhydric and nitrous acid gases, chlorine, sulphuretted hydrogen, cyanogen, and some other gases. Göppert about the same time published some investigations upon the influence of cyanhydric acid. The effect of all these substances was very much what might have been anticipated from their tendency to attack organic tissues.

The examinations which I propose here to describe have been made in a somewhat different direction. The most curious result obtained appears to me to be that relating to the effect of a highly ozonised atmosphere upon the roots of plants. I have also found that organic substances not in the least corrosive, and even entirely neutral, may exercise a powerfully poisonous influence upon vegetation, when disseminated in the atmosphere surrounding it.

1. Influence of Ozone.—The ozone used in the following experiments was generated by the action of sulphuric acid upon chameleon mineral. Two or three grains of chameleon mineral were placed in a small capsule and moistened with oil of vitriol. This, when placed by itself, or with a vessel of water under a bell-glass of about three litres capacity, was found to maintain a highly ozonised atmosphere for five or six days, or even longer. But as the presence of vegetation would tend to destroy the ozone rapidly, it was considered expedient to renew the generating mixture every two or three days. In all cases the capsule was placed aside for half an hour or more to allow the red vapours to be thoroughly dissipated before introducing it beneath the bell-glass.

Two sets of experiments were made: in the first, the water with which the seeds came in contact was made to contain those solid substances which are most essential to vegetation. In the second, very pure river water was used. For the first, phosphate of soda, silicate of potash, sulphate of magnesia, nitrate of lime, and sesquichloride of iron were added to water in a proportion such as to be equivalent to three-tenths of 1 per cent. of solid matter. In order to afford a just term of comparison, two vessels every way similar were filled with this prepared water, were covered with gauze so that the gauze should rest on the surface of the water, and were placed under bell-glasses resting on glass plates. Wheat and maize grains were placed on the gauze, and beneath one bell-glass was introduced the ozone-generating mixture.

2nd day.—Germination appeared to be more advanced in the vessel containing the ozone. Seeds, however, of like origin, and exposed to the same influences, germinate so irregularly that much importance is not to be ascribed to this.

3rd day.—The seeds in ordinary air had overtaken the others. They were already covered with mould, of which no sign appeared on those exposed to ozone.

4th day.—Mouldiness much increased in the one, still none in the other. The rootlets of the plants exposed to ozone begin to exhibit remarkable effects, extending themselves upwards instead of downwards, and becoming pinkish at the extremities.

5th day.—Ozone plants much behind.

8th day.—The disposition of the roots of the plants exposed to ozone to grow upward still continues. Of the wheat plants, fully one-half the rootlets have shot directly into the air. The only maize plant which has as yet germinated has sent up a healthy plumula over one inch in length; its three rootlets are all directed upward and away from the water. Nothing in the least similar has taken place in any of the seeds not exposed to the influence of the ozone.

12th day.—The experiment was terminated. The average height of the wheat plants not exposed to the ozone was ten inches; of those exposed, four inches. The effect of the ozone in checking the growth of the roots was very remarkable, especially with the wheat plants. In those not exposed to ozone, the roots attained a length equal to about one-fourth the height of the stem. In those exposed to it, the roots after starting almost immediately ceased to grow; the strongest plant attained a height of six inches, and developed six rootlets, averaging only three-sixteenths of an inch in length, while those not exposed to ozone had many roots exceeding two and a-half inches. As a whole, the roots produced by the plants under the influence of ozone did not exceed one-tenth of those produced in its absence from an equal number of healthy seeds. One curious result of the almost total absence of roots was that the wheat plants were scarcely able to sustain themselves in a vertical position; the greater part of them fell over on one side. The flatness of the grains of maize afforded their plants a better support.

The influence of ozone over the production of mould was very striking. When seeds were placed in contact with water and with the air under a bell-glass in which a vessel of water stands, which air is of course saturated with moisture, mould began immediately to form, and increased until the surface of the gauze which rested on the water was completely covered. Nothing of the sort was visible in the bell-glass containing an ozonised atmosphere.

In order the better to observe the influence of ozone upon the mould, the vessel which contained it was transferred to the bell-glass of which the atmosphere was ozonised. In the course of a few hours, the greater part of the mould fell back upon the gauze as a yellowish powder, while two healthy young maize plants appeared unaffected, and continued their development. With a longer exposure, they would of course also have suffered, but their stronger vitality enabled them to resist longer. It was also remarked that the extremities of the leaves of some wheat plants, growing in the same vessel, became yellow. But those wheat plants which had germinated in the ozone atmosphere, although much smaller, were perfectly healthy, and the leaves showed no disposition to die at the ends.

Pasteur has lately shown that the putrefaction and oxidation of organic bodies is effected to a very large extent by the intervention of the lowest order of vegetable organisms. That in some cases where the germs of these bodies have been carefully excluded, milk, for example, has been kept in the presence of atmospheric air for a year without alteration; and that when sawdust was enclosed in a flask for a month, the germs being similarly excluded, the air still contained 16 per cent. of uncombined oxygen.* It therefore appears that ozone, while a highly oxidising agent, may in some cases check putrefaction and oxidation by destroying the intermediate agencies, through which these operations are effected; a fact not without interest in connexion with the alleged influence of ozone on epidemics.

The experiments just described were carefully repeated with the substitution of very pure river water, instead of that containing the salts already mentioned. The results obtained were precisely the same. These trials afforded a double set of parallel experiments, similar sets of seeds having been exposed to the action of saline solutions, and to that of river water nearly pure, in both cases with and without the influence of ozone. Clearly, therefore, to nothing but ozone could be ascribed the inverted tendency of the roots, as this always followed its presence, and never appeared in its absence.

2. Carbonic Acid.— Experiments were made to ascertain the effect of a complete removal of carbonic acid from the atmosphere surrounding plants. The seeds were placed on gauze strained over a vessel of water, which was set in a dish containing concentrated solution of caustic soda, and the whole was covered with a bell-glass. A similar arrangement was made, exclusive of the caustic alkali, to afford a term of comparison.

No appreciable difference could be observed. It is probable that seedlings, within the height which they can attain under an ordinary bell-glass, still derive a sufficient supply of carbon from the seed. Be this as it may, the removal of carbonic acid from the atmosphere surrounding them did not interfere with their growth.

Experiments made with seeds placed in an atmosphere of carbonic acid accorded with results obtained by other observers, as to total prevention of germination under circumstances otherwise favourable. The seeds, however, were found to be not in any way injured, and germinated freely on exposure to the atmosphere.

It seems probable that in those cases in which germination has been observed to take place in an atmosphere of carbonic acid gas,† the exclusion of atmospheric air has not been sufficiently well maintained.

3. Simple and Compound Ethers.—Seeds were placed on gauze under a bell-glass, as before, and an open narrow-mouthed phial containing a little ether was introduced. Germination was entirely prevented.

Nitrate of methyl produced a similar effect.

4. Organic Acids in Solution.—Two organic acids were selected for experiment—oxalic acid as being reducing, non-nitrogenous, and sharp; picric acid as oxidating, nitrogenous, and bitter. Both were dissolved in water in the proportion of three-tenths of one per cent. Germination was found to be entirely prevented, by the presence of even so small a quantity of these substances. To ascertain if this effect resulted from the acid reaction of the solutions, other solutions were made of oxalate and picrate of ammonia, so proportioned that each solution should contain precisely the same proportion of acid as before—viz., three-tenths of one per cent. In the neutral solution of oxalate, a slow germination followed; in that of picrate none whatever.—*American Journal of Science and Art*, Vol. xxxvii., May, 1864.

Note on a Coloured Derivative of Naphthaline, by M. Carey Lea.

In the course of an examination of the compounds of naphthaline, the following observation was made, and, as at the present day, every coloured reaction belonging to the products of coal distillation is a matter of interest, I publish it.

While preparing some sub-chloride of naphthaline, $C_{20}H_8Cl_3$, by passing chlorine over naphthaline, I washed the crude product with ether, and separated the etherial liquid by filtration. By exposure to the atmosphere the ether passed off; there remained a small quantity of a pale yellow transparent watery acid liquid, which separated itself from the denser and more coloured portions. Placed by itself in a small capsule, it deposited after a time a bright blue film. The liquid was passed off from this film into another capsule, when it gradually deposited a further portion.

The quantity of this blue substance obtained was exceedingly small. It exhibited the following properties:—It was insoluble in water, in alcohol, and in ether. Exposed to an ammoniacal atmosphere, it passed quickly to a full deep purple; vapour of chlorhydric acid restored the blue shade. Ammonia in the form of solution wholly destroyed the colour, nor was it then restored by chlorhydric acid as when it had been rendered purple by ammoniacal vapour.

This reaction of a blue substance changed to purple by a small quantity of ammonia, and wholly decomposed by excess, is something quite new, and it is to be regretted that the substance is only obtainable in infinitesimal quantities as a by-product.—*American Journal of Science and Arts*, vol. xxxviii., November, 1864.

TECHNICAL CHEMISTRY.

On the Chemical Effects of Incandescent Fuel on Steam Boilers, and the Chemical and Physico Chemical Effects of the Feed water, by F. A. Paget, *Esq., C.E.*

(Continued from page 220.)

An explanation which seems to meet all the circumstances of the case is the following:—Mr. Mallet, in a report addressed to the British Association some years ago, showed that wrought iron and steel (blister steel probably), "consist of two or more different chemical compounds, coherent and interlaced, of which one is electro-negative to the other." In fact, ordinary wrought iron, being also welded up from differently worked scrap, is far from being an electro-homogenous body. In a boiler, the hot water, more or less saturated with chemical compounds, is the exciting liquid, and the electro-positive portions of the plates are thus quickly removed to a greater or less depth. This explanation meets most of the known circumstances with respect to pitting; it even, in a great measure, explains how plates above the level of the water, especially in marine boilers, get very rapidly corroded in portions, while another part of perhaps the same plate is scarcely affected. The concentrated water in a marine boiler is known to be generally acid. "Of all the salts contained in sea-water," says Faraday,‡ "the chloride of magnesium is that which acts most powerfully" on the plates. He shows that a cubic foot of sea-water contains 3·28 oz. of this salt; and, at the same time, points to the danger of voltaic action in a boiler through the contact of copper

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* See *Rep. de Chemie Pure*, September, 1863, p. 479.

† Lindley, "Introduction to Botany," p. 359.

‡ Fifth Report of the Committee of the House of Commons concerning the Holyhead Roads, p. 194.

and iron. In a smaller degree the contact of cast with wrought iron, or between the different makes of wrought iron in the same plate, or between contiguous plates, acts in the same way. It is not improbable that some hydrochloric acid is present in the steam of marine boilers. "Mr. J. C. Forster§ has tested some of the condensed steam from the safety-valve casing, and from the cylinder jacket of the Lancefield, and found both decidedly acid."‖ With an exciting liquid in the condensed steam, it is thus explicable how the plates of marine boilers often get corroded in a most capricious manner; while at the same time, the current of steam would create a certain amount of friction on the oxide, clearing it away to act on a fresh surface.

The crucial test of this explanation of pitting would be the observation of the absence of the phenomenon from plates of an electro-homogenous character. This homogeneity could only be expected from fused metal, such as cast-steel. Accordingly, while the writer was in Vienna a short time ago, he was assured by Mr. Haswell, the manager of the Staatsbahn Locomotive Works, that some locomotives made of cast-steel plates in 1859, for the Austrian Staatsbahn, had been working ever since without showing signs of pitting, though under similar conditions iron plates had severely suffered in this way. Pitting may thus be fairly defined as a form of corrosion localised to particular spots by voltaic action. It is also probably aggravated through through the motion of the plate by mechanical action, and the expansions and contractions through alternations of temperature. All boilers are most pitted near the inlet for the feed water, and with inside cylinder locomotive boilers there is generally more pitting at the smoke-box end—no doubt caused by the more or less racking action on these plates. A state of corrosion at particular spots would probably be kept up to a greater intensity by the incrustation being mechanically thrown off. With a quicker voltaic action, caused by any unusual intensity of the exciting liquid, the sides of the cavities in the plates would be sharper and less rounded off; as in the case of the boiler fed with mineral water from ironstone workings, which exploded last year at Aberaman, South Wales. (See Fig. 2.)

The fact that pitting occurs in marine boilers when distilled water from surface condensers is used, does not affect this explanation. Water distilled in this way, from whatever cause, after repeated boiling, is stated to carry the salinometer even higher than sea water, thus proving that it is not pure.¶ In the next, there is the absence of incrustation, which to some extent always protects the plates of boilers from the chemical action of its contents. In this way the mechanical buckling of the plates—directly and indirectly causing the furrows we have spoken of—by continually clearing particular lines of surface from incrustation and oxide, reduces these particular spots, with respect to corrosion, to the condition of the plates of a boiler fed with water which deposits no incrustation. Corrosion will also act more rapidly at a furrow through mere increase and renewal of surface. To resist that form of internal corrosion especially known under the name of pitting, a maximum of electro-homogeneity is evidently required in all the component parts of the boiler.

FIG. 2.

(From a photograph of surface of corroded plate cut from one of the two boilers that exploded on Wednesday, February 17, 1864, at Aberaman Iron Works, Aberdare. The corrosion was internal, and in some parts the plate was not more than one-eighth thick. Thirteen persons were killed and many others seriously injured.)

While the action of internal corrosion, often very equally corrugating the plates over a large surface, as a rule scarcely, at any rate only gradually, affects their mechanical strength, external corrosion, being localised to particular spots, is of a much more dangerous character. The one is gradual and easily perceptible, while the other is rapid and insidious in its progress. Apart from accidental circumstances affecting the brickwork on which a stationary boiler is erected, or the outside of the bottoms of marine boilers, it is clear that external corrosion can only occur through leakage. When leakage takes place through a crack in the plate caused by mechanical action, or at a hole burnt out by heat, the effects of leakage are only secondary results, due to a primary cause which of itself may cause the stoppage of the steam generator. But a leakage at a joint may in itself gradually cause the destruction of the boiler. Here we see another reason that the character of a boiler, not merely as to ultimate strength, but also as to wear and tear, intimately depends upon the form of its joints. It is often noticeable that very good lap joints, even when tested under hydraulic pressure up to only 50 per cent. above the working load, sweat more or less. The tendency of the internal pressure to form a correct circle bears indirectly on these joints, causing them to open more or less, and to leak, in spite of the caulking. Mr. Robert Galloway, C.E., who, as an engineer surveyor of long standing of the Board of Trade, has probably made more than 3000 careful inspections of marine boilers, states that he has often noticed a furrow or channel on the outside of the joint, running parallel to the outside overlap for some distance, and evidently caused by leakage. Along the water line, condensed water will act on the joints, while below it the concentrated contents of the boiler will come into chemical action. A leakage in a marine boiler often eats away a plate within a year. In some cases a jet of hot water from a leakage has a frictional action; in fact, even with such an incorrodible and hard substance as glass an

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§ Institution of Engineers in Scotland, 1864—5. Introductory address by Mr. J. R. Napier.

‖ When a solution of chloride of magnesium is evaporated nearly to dryness, the salt and the water are decomposed, magnesia and free hydrochloric acid being formed; or $MgCl + HO = MgO + HCl$.

¶ Institution of Mechanical Engineers, 1863. Discussion on Mr. James Jack's paper "On the Effects of Surface Condensers on Steam Boilers."

effect like this has been perceived, and a slight leakage continued during several days sometimes produces a noticeable furrow on a glass-gauge tube. With sulphurous fuel, a powerful chemical-action will come into play on the plates. One volume of water takes up about thirty volumes of sulphurous acid gas; and these sulphurous fumes of the fuel, coming into contact with the water from a leakage, will be more or less absorbed. An acid solution like this must quickly eat away the plate. It is certain that a leakage acts much quicker on a boiler fired with sulphurous fuel than on one fired with wood. M. G. Adolphe Hirn has observed a plate, nearly seven-eighths thick, to be pierced, in the course of time, as with a drill, by means of a little jet which struck it after passing through a current of hot coal smoke.[**]

PHARMACY, TOXICOLOGY, &c.

Mysterious Case of Poisoning at Dawlish.

A RECENT number of the *Western Times* informs us that the Dawlish people have lately been much excited by a rather remarkable case of suicide committed at the York Hotel. We have been interested in this case on account of certain physiological and forensic circumstances associated with it, a trustworthy account of which we have received from a correspondent, and with the main points of which we shall now make our readers acquainted. The lady who committed suicide had several parcels of "rat poison" in her reticule or about the room, some of which had been opened, others kept as if in reserve. Two papers of "Simpson's vermin killer" and one parcel of Battle's had apparently been used. Some blue stains were found in the mouth and at the angles of the jaw, the pocket handkerchief being also stained in like manner. The rigidity and contortions of the dead body led Dr. Baker, of Dawlish—who was called in to see the deceased when she had been dead two or three hours—to infer that strychnia had been the cause of death. He sent the viscera to Dr. Bird Herapath, of Bristol, who from analysis proved that arsenic was present in abundance in the gastric mucus and in the coats of the stomach, but that strychnia was not in either of these materials. Dr. Herapath found likewise traces of arsenic in the liver. What is the explanation of this discrepancy of analysis and condition of body and mode of death? As Dr. Herapath observes, if strychnia were taken it never got into the stomach at all. It is probable, however, as this gentleman explains it, that the first two packets did not kill her as quickly as she intended, and that she then took the third packet, but that its contents never went further than the mouth. Some portion was ejected in consequence of the bitter taste, and to get rid of what remained of the latter an almond was taken. Enough, however, of the powder (starch, Prussian blue, and strychnia, similar to what was employed in the Vyse case) remained behind to kill by absorption through the mucous membrane of the tongue, &c. The Coroner, at the adjourned inquest, declined Dr. Herapath's evidence, as he had not given any order for a chemical analysis, and now objected to the county being put to the expense. "He said there could be no doubt that the case was one of suicide, therefore an analysis was unnecessary." The magistrates were very particular, and would not allow the expenses. Dr. Baker said the Coroner had left the case with him. A country practitioner was not supposed to make an analysis, and he (Dr. Baker) was not prepared to state the cause of death, unless the evidence of Dr. Herapath was taken. Dr. Herapath said the law was at fault, as a medical gentleman was allowed only two guineas for making a post-mortem examination, and no man of education could be expected to do it for that sum. The Coroner replied that he could not and would not let medical gentlemen act as Dr. Baker had done without the Coroner's instructions. Dr. Herapath then made a voluntary statement, foregoing the usual fee. "He stated that death had been caused by arsenic, a quantity of which, found in the stomach, he then produced. The jury heartily thanked him for his kindness, and returned a verdict in accordance with his testimony, and that the deed was done during temporary insanity."

The medical man should have informed the coroner that an analysis was necessary, and in such a case as this the order for it would have been given as a matter of course, and Dr. Herapath would then have received his proper fee.

PHYSICAL SCIENCE.

On the Application of Spectrum Analysis to Microscopical Investigations, and especially to the Detection of Blood Stains,[††] *by* H. C. SORBY, *F.R.S.*, *&c.*

(Continued from page 196.)

If blood be dried on white linen, and exposed to the air, the bright scarlet colour changes by degrees into brown. This fact must be well known, but so far as I am aware, has not been studied optically or chemically. When the change has not proceeded far, the blood yields a spectrum like that shown by No. 3. The two well-marked bands in the green are much the same as in fresh blood; but there is also one in the red, having its centre at 1⅓ above D; and, therefore, a trifle lower than Fraunhofer's line C. The intensity of this band shows the amount of change; and, when it has become complete, the spectrum is very different from that of fresh blood, as shown by No. 4. In this change the bands below D in the green become more and more faint, especially the upper, which finally is only just visible. A larger quantity of blood is required to show spectrum No. 4 than to show No. 2; and if the solution be strong enough, only a dirty-brown red light is transmitted, with a dark band in its centre. When kept under similar conditions, the extent of this change serves to show the length of time since the blood was fresh; and at one time I hoped that by this means it would be possible to determine the time with some confidence, which would often have been very valuable in criminal inquiries. In some cases it might, indeed, be made available, but in and near a town it could not be relied on at all. When sealed up in a glass tube in a perfectly dry state on linen, it would give such a spectrum as No 3, after having been kept for two or three months; but when sealed up wet, there is apparently little or no such change. It thus appears that it partly depends on being dry, but will take place independently of being exposed to atmospheric influences. These, however, greatly accelerate it. Exposed to the air on Burbage-moor, six miles from Sheffield, and about 1000 feet higher, one or two miles from any house, the change took place more rapidly, so that the spectrum was nearly as No. 3, after a week or so; whereas in the centre of

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[**] *Bulletin de la Société Industrielle de Mulhouse*, 1861, p. 558.

[††] From the *Quarterly Journal of Science*.

the town as much action took place in a few hours. Kept in the house, the rate of change varies very much accordingly as gas is burned in the room or not; and, when I had ascertained this fact, I concluded that it must be due either to carbonic or sulphurous acid. I therefore kept some in a flask with carbonic acid, without being able to perceive any marked effect, whereas sulphurous acid disseminated in a large quantity of air turned it brown very soon, and caused the spectrum to change from No. 2 to Nos. 3 and 4; but if much acid be present, it produces a more complete decomposition, and the absorption-bands are not so distinctly visible. It appears, therefore, that this change in the colouring-matter takes place in dry blood, whether exposed to the air or not, but is greatly accelerated by free exposure to fresh air, and especially by the presence of the sulphurous acid produced by the combustion of coal or gas. Light appears to have little or no influence. Carrying out the nomenclature of Professor Stokes,‡‡ I suggest that the brown colouring matter thus produced should be called "brown cruorine." Though it is apparently dissolved by water, and yields a clear solution, yet it is doubtful whether it is soluble in the most strict sense of that term. Close-grained filtering paper removes a great part, and on standing for some time the finer particles collect and subside. It is also difficult to dissolve it from linen or similar material without repeatedly moistening and squeezing it with forceps, so as to detach the minute particles, some of which remain quite firmly attached; and on the whole it is an excellent example of a connecting link between substances that are really dissolved by water and those which can only be disseminated through it in comparatively large particles.

If ammonia be added to a solution which would give such a spectrum as No. 4, we obtain one like No. 5. The band in the red disappears, those in the green become far more distinct, and the spectrum is similar to that of fresh blood, only the bands are more faint, and it is slightly shaded up to half above D.

If a small quantity of a strong solution of this brown cruorine be placed on a piece of glass, and allowed to evaporate slowly, the greater part collects as a dry film round the outside of the drop; and, when examined on the stage of the microscope, it yields a spectrum like 4 or 5, accordingly as it is damp or quite dry. If dry, the spectrum is very similar to that of fresh blood, only the absorption-bands are less distinct; but when breathed on, so that it may again become damp, the dark band in the red makes its appearance, and those in the green become more faint. These changes take place over and over again, though they gradually cease after some days; and hence it would appear that the dark band in the red depends on the presence of moisture, and may be due to the formation of some hydrous compound, decomposed on drying. The scarlet cruorine of fresh blood, treated in the same manner, exhibits no such changes, and gives the same spectrum as its solution in water.

Drying solutions of blood on glass in this manner gives very satisfactory results, and specimens so prepared may be kept in that state, or under thin glass fixed down with Canada balsam, without there being any sensible alteration after above half-a-year. The solution may be placed on a small square of thin glass till it has evaporated and become reduced to a drop or so, and then, having re-dissolved the dry part in the liquid, it may be allowed to run off at one corner to the glass on which it is to be kept, leaving the minute [illegible] fragments behind. If, however, the mordants used in dying the fabric have changed the blood to hæmatin, the results are not satisfactory. A solution of fresh blood mounted in a cell still gives the characteristic spectrum after some months, though more faintly than at first. Brown cruorine soon forms a deposit, and loses its character when thus kept.

Professor Stokes has described the change produced by the action of deoxidising agents on fresh blood. Whether the cruorine be fresh and scarlet, or have been more or less converted into the brown modification, if citrate of ammonia be added to an alkaline solution, so as to prevent the precipitation of oxide of iron, and then, having introduced it into a cell, if a small piece of crystallised protosulphate of iron be added, and broken up and stirred till dissolved with a platinum wire flattened at one end and bent at right angles so as to form a sort of little hoe, we obtain the spectrum No. 6. There is one well-marked absorption-band, the centre of which is $1\frac{1}{8}$ below D, and a general shading upwards as far as D. Hence it is clear that the change from scarlet to brown cruorine is not of such a nature as to prevent both from yielding the same spectrum when deoxidised; or, as described just below, from most readily passing into hæmatin, when acted on by a weak acid. So far I have been unable to decide whether the difference consists in brown cruorine containing more oxygen or water, or in its being only an isomeric modification of the scarlet. However, since such a powerful oxidising agent as permanganate of potash does not produce it, and since it is not formed in solution or when damp, the latter supposition appears to me to be the most probable, unless, indeed, it contains less water.

Professor Stokes has shown that weak acids convert cruorine into hæmatin,§§ and has described the spectrum produced by it in its natural state and when alkaline and deoxidised. On adding acetic acid to a solution of either scarlet or brown cruorine, a spectrum is obtained like that shown by No. 7. There is a well-marked absorption-band in the red, the centre being situated at $1\frac{1}{2}$ above D, and, therefore, rather higher than that in the case of brown cruorine, and very nearly in the position of Fraunhofer's line C. There is also another at about 1·4 below D, and perhaps a third still lower, which is only seen when the solution is more dilute, and even then so obscurely that its existence appears doubtful. When dried on glass the band in the red does not disappear; and when the solution is strong, ammonia causes a precipitate, as though hæmatin were much less soluble in ammonia than either scarlet or brown cruorine. However, the solution being somewhat dilute, using about $\frac{1}{3}$rd or $\frac{1}{4}$th of a grain of citric acid to prevent the subsequent precipitation of oxide of iron, adding ammonia in decided excess, and introducing the whole into a cell; if about $\frac{1}{20}$th or $\frac{1}{30}$th of a grain of crystallised protosulphate of iron be dissolved in the solution, we obtain the very well-defined spectrum of deoxidised hæmatin shown by No. 8. The centre of the upper band is $\frac{7}{8}$ths below D, and of the lower at 2. The upper part is about $\frac{1}{2}$ wide, very dark, and sharply defined; the lower nearly the same width, but much more faint. Neither is much shaded at the edges, and both vary more in darkness than in width, on increasing or decreasing the strength of the solution or the length of the cell in which it is examined. When concentrated and in a tube $\frac{1}{2}$ an inch long, the width of the bands is much as shown, but the shaded part is darker. In a tube $\frac{1}{8}$th of an inch in diameter, a spectrum as distinct as No. 8 is given by $\frac{1}{100}$th of a grain of liquid blood,

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‡‡ *Proceed. R. S.*, xiii., 355

§§ *Proceed. R. S.*, xiii., 357.

making on thin linen a spot about $\frac{1}{16}$th of an inch in diameter; and such a minute quantity will show the bands faintly, yet distinctly, that $\frac{1}{1000}$th of a grain of blood would be quite enough to furnish us with unmistakable evidence of its presence, if some little care and trouble were taken over the experiment, and the solution examined in a cell not more than $\frac{1}{16}$th of an inch in diameter.

(To be continued.) 234

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, April 28.

"*On the Food of Man in relation to his Useful Work.*" By LYON PLAYFAIR, C.B., LL.D., F.R.S.

(*Continued from page 224.*)

DIVISION II.

Application of the Preceding Data to Elicit the Source of Useful Work.

13. The common experience of mankind teaches us, that when work is to be obtained from an animal, it must be supplied, in proportion to the labour, with food rich in flesh-formers. Thus a horse, when at work, must be fed with oats or beans, both rich in flesh-formers; a supply of potatoes or turnips, both abounding in heat-givers, would not enable it to do its work. Professor Dick, the head of the Veterinary College in Edinburgh, tells me that a horse may be kept without work, but taking a little exercise, in fair condition, on 12 lbs. of hay and 5 lbs. of oats; but if a good amount of work is to be got out of it, the horse should get 14 lbs. hay, 12 lbs. oats, and 2 lbs. beans. These diets reduced, as regards their flesh-formers, are as follows:—

Horse at rest . 29·2 ozs. of flesh-formers.
Horse at work . 56·2 ,, ,,

Diff. for work 27·0 ,, ,,

The labour of a horse is generally taken as equal to that of between seven and eight men; and as the working food of a labourer is 5·5 — 2·0 = 3·5, the proportion

$$3{\cdot}5 : 27 :: 1 : x,$$

in which $x = 7{\cdot}7$ leads to the same result. Again, if we compare the labour and food of a horse and of a man when doing the same kind of work—that is, pulling weights horizontally—we have the following ratios, which, from the different character of their food and assimilative processes, must be made upon the flesh-formers actually expended on work external to their body:—

$$\begin{array}{l}\text{Work of horse, Morin}^{*}\\ \text{Work of man, Rankine}^{\dagger}\end{array}\ \frac{12{,}400{,}000}{1{,}500{,}000} = 8.$$

$$\begin{array}{l}\text{Labour flesh-formers in the food of horse}\\ \text{,,}\quad\quad\text{,,}\quad\quad\text{,,}\quad\text{food of man}\end{array}\ \frac{27}{3{\cdot}5} = 7{\cdot}7.$$

These ratios are as near as we can expect with animals of such a different character. If we take again two labouring animals of the same herbivorous nature—the ox and horse,—we can compare their labour and food without complicating the question by deducting the quantity required for *opus vitale*. The Sussex farmers find that an ox is well fed on 50 lbs. mangold-wurzel, 3 lbs. beans, and 17 lbs. wheaten straw, the flesh-formers in this food being 38·6 oz. Muschet[‡] has given us the labour of an ox, from which we obtain the following ratios:—

$$\begin{array}{l}\text{Work of horse in foot-pounds,}\\ \text{Work of ox}\quad\quad\text{,,}\end{array}\ \frac{12{,}400{,}000}{8{,}640{,}000} = 1{\cdot}43.$$

$$\begin{array}{l}\text{Plastic food of horse,}\\ \text{,,}\quad\text{food of ox,}\end{array}\ \frac{56{\cdot}5}{38{\cdot}6} = 1{\cdot}46.$$

14. These numbers, so far as they go, appear to indicate that the external dynamical work of animals is proportional to their plastic food. But this is only the common experience of man. The miners in Chili, who work like horses, also feed like them, for Darwin tells us that their common food consists of bread, beans, and roasted grain. During our harvest in Scotland, the reapers consume about eight ounces of plastic nutriment daily (Christison). Our railway contractors know this necessity of the system so well that they are accustomed to discharge labourers when their appetites fail (Lankester). And, generally, the previous diet tables prove this amply, by showing a constant increase of 30 per cent. of flesh-formers in a labouring diet over one fitted for health without hard work, as contrasted with a varying increase of from 5 to 20 per cent. in the heat-givers.

15. Having thus rendered it probable that we are to look to the plastic ingredients of food as exponents of dynamical action, both internal and external to the body of a man, let us now examine the transformations which they suffer. All chemists are agreed that the final transformation of plastic matter in the body yields carbonic acid, water, urea, and sulphuric acid. Those who believe that the transformation takes place in the blood agree on this point with those who consider that it is effected in the tissues.

If we take the simplest possible *empirical* formula for albumen, or of tissue formed by it, one representing analysis merely, and not constitution, our views may be more easily understood. Such a formula is $C_{24}H_{38}N_6O_{16}$, in which the 1·2 per cent. of sulphur is for the present supposed to play the part of oxygen:—

		Calculated.	Mean of analysis.
24 C, . .	288	53·55	53·8
38 H, . .	38	7·06	7·0
6 N, . .	84	15·61	15·7
16 O, . .	128	23·78	S 1·2 O 22·3
	538	100·00	100·0

The transformation of this generic tissue-forming body, still omitting the sulphur, would be as follows:—

$$\overset{\text{Albumen.}}{C_{24}H_{38}N_6O_{16}} + 100O = 3\overset{\text{Urea or amido-carbonic acid.}}{(CO_2(NH_2)_2)} + 21\overset{\text{Carbonic acid.}}{(CO_4)} + 13\overset{\text{Water.}}{(H_2O_2)}$$

The simplicity of the transformation is remarkable. Water and two forms of carbonic acid are alone produced; of the latter amido-carbonic or urea is secreted with water *per vesicam*, and the gaseous carbonic acid, accompanied by watery vapour, passes away *per halitem* or *per cutem*. If this empirical formula be a fair representation of analysis, and it claims to be nothing more, then, as the result of the transformation, *seven* times as much carbon should escape by the lungs and skin as by the urine. We can only test this when animals are fed on a flesh diet free from fat. Luckily there are two classes of experiments of this kind, one of them being by Bischof and Voit,[§] and the other by Pettenkoffer and Voit.[‖] The results of the former, omitting the starving experiments on the dog, are as follows:—

	Grammes of Flesh.	C in Urea. Grammes.	C in CO_4. Grammes.
First Series .	1800	24·2	180·8
Second ,, .	1500	21·6	162·1
Third ,, .	1200	17·7	132·6
Fourth ,, .	1800	24·9	186·5
Fifth ,, .	1800	25·6	223·3
Sixth ,, .	2000	30·3	228·5
Mean . .	1383	24·0	185·6

Before using these figures, we must correct them for the one per cent. of fat which, according to these authors, still remained in the flesh. If we suppose the fat to contain 77

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[*] Morin, *Mech. Trans.*, by Burdett, p. 397.

[†] *Ency. Brit.*, article Mechanics.

[‡] As quoted in Rankine's "Mechanics."

[§] *Die Gesetze der Ernährung der Fleischfressers*, S. 61, *et seq.*

[‖] *Ann. der Ch. and Phar.*, Supp. Bd., 1863.

per cent. of carbon, then 13·83 grammes of fat, in the average daily supply of 1383 grammes of flesh, would contain 10·6 grammes of carbon. Hence we have in reality 175 grammes of the carbon in the carbonic acid due to the flesh alone. From this we obtain the ratio—

$$24 : 175 :: 1 : x \quad . \quad . \quad . \; x = 7·29.$$

In Pettenkoffer and Voit's experiments, conducted in a like way, but where no correction requires to be made for fat, 21·6 grammes of carbon were found in the urea, and 148 grammes in the carbonic acid, and small quantity of carburetted hydrogen, which escaped by the lungs and skin. Hence we have—

$$21·6 : 148 :: 1 : x. \quad . \quad . \; x = 6·85.$$

The mean of these two independent series of experiments shows that 7·07 times as much carbon passes away in the form of carbonic acid as we find in urea, our equation having required 7·0.

16. Having established the fairness of the equation of transformation, we have to ascertain its calorific value. Although we are well aware, as has been shown by Berthelot[¶] and others, that this depends for absolute truth on a thorough knowledge of the rational constitution of a body, this need not prevent, until the progress of knowledge teaches us this, our use of approximative numbers. These we can obtain by the following scheme :—

21 C becomes 21 CO_4, carbonic acid.
3 C „ 3 CO_2, carbonic oxide.
26—16 H „ 5 H_2O_2, Water.

In this scheme the hydrogen is reduced to ten atoms, because there are already sixteen atoms of oxygen in the tissue, which may be supposed to have united with that element without increase of temperature. The calorific units employed are those of Andrews—viz., 7900 for carbon, 33,808 for hydrogen, and 2307 for the 1·2 per cent. of sulphur in albumen. We do not know experimentally how much heat is given out when carbon unites with oxygen to produce carbonic oxide; but as we do know how much the latter gives out on becoming carbonic acid, it is easy to calculate how much heat a gramme of carbon would evolve on becoming carbonic oxide. The unit of heat by this calculation would be 2227·7. It will now be convenient to ascertain by these numbers how much heat would be given out by the transformation of one ounce or 437·5 grains[**] (28·35 grammes) of tissue. A little calculation shows that this quantity would yield as much heat as would raise 126·5 kilogrammes of water 1° C. This, converted into its mechanical equivalent, gives :—

$$126·5 \times 425 = 53,762 \text{ metre kilogrammes.}$$

17. These numbers can easily be applied. Thus we have seen that a labourer receives 5·5 oz. (155·92 grammes) of flesh-formers in his food. The potential energy represented by this quantity is 295,691 metre kilos.; while the man's labour of raising his own weight one mile high per day is 109,496 metre kilos. But we have not yet deducted the amount of energy required for *opus vitale*, in which we include internal, dynamical, mental, and assimilative work. Concurring estimates of the force exerted by the heart have been made by Helmholtz[††] and Haughton.[‡‡] The latter estimates it at 122 foot-tons, or 273,280 foot-pounds, which is more than one-third of the useful work done out of the body. Now, although the motion of the blood in the human body depends almost entirely upon the heart, there are at least indications in man, and clear evidences in plants,[§§] and in the lower animals, that there are other movements in the system without any *vis a tergo* from an impelling body. If the heart do not use the energy placed at its disposal more economically than the conscious man does the amount with which he works, then it would require nearly one ounce, or exactly 1·20 oz. (theoretically, 0·702 oz. should suffice) of the plastic food. This is very nearly one-half of that which is required for subsistence. The two ounces of flesh-formers used in subsistence would yield by their transformation 253 units of heat, or a mechanical equivalent of 107,524 metre kilos., while the work of the heart is only 37,781 metre kilos. But in addition to the other dynamical work within the body, there is also included in this subsistence quantity both a limited amount of mental work and a full proportional of assimilative work. In the dynamical work, besides the cardiac movements, there are those of the respiratory apparatus, of the diaphragm, of the intestines, and of the arteries. All these in the aggregate represent a considerable, though numerically unknown, demand upon plastic food. And finally, we have the mental work, not considerable certainly, in a man fed upon a minimum diet, but probably requiring a certain amount for the manifestations of mind to the material world. We cannot therefore be surprised to find that double the amount of energy necessary for the cardiac movements is supplied for the whole functions included in *opus vitale*.

18. The *opus mechanicum* or external dynamical work done by the body of a hard-worked labourer, is to be sought in the 3·5 ounces (99·2 grammes) of flesh-formers which remain after deducting the amount required for *opus vitale* from the total plastic food. But of this quantity one-twelfth appears in the alvine evacuation, without being formed into tissue, and the remainder yields 405 units of heat, or its mechanical equivalent of 172,125 metre kilos.; while the actual amount of useful work performed by the man is 109,496 metre kilos.

19. When we contrast the useful work of a steam-engine with the potential energy supplied to it, this economy of force on the part of the man must appear surprising. But even in the rough mode of calculation available to Scoresby and Joule, to Dumas and Helmholtz, before our knowledge of dietetics had enabled us to consider this question in a more precise way, the relative economy of the human machine excited their surprise. And yet our demand for economy is much greater than they supposed to be necessary, for we require that more than half of the potential energy should be converted into useful work.[||||] It may be therefore necessary to adduce general arguments in support of the view that the dynamical action of the body depends wholly on the transformation of the tissues.

(To be continued.)

Friday Evening, May 12, 1865.

"On Magenta and its Derivative Colours."

By **Frederick Field, F.R.S.**

Three years ago, in this theatre, Dr. Hofmann delivered his celebrated lecture on mauve and magenta, and it might

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[¶] Acad. de Science, January, 1865.

[**] The details of this calculation are as follows :—
One ounce of albumen contains—

Carbon	235·37	grains
Hydrogen	30·62	„
Nitrogen	68·68	„
Sulphur	5·25	„
Oxygen	97·56	„
	437·48	

This, treated according to the equation given :—

C. 201·75 × 7,900 = 1,593,825
C. 33·62 × 2,227·7 = 74,895
H. 8·05 × 33,808 = 272,154
S. 5·25 × 2,307 = 12,111
1,952,985

$$\frac{1,952,985}{1 \text{ kil.} = 15,432 \text{ grs.}} = 126·5$$ kilogramme units. To convert this into mechanical force :—

$$126·5 \times 425 = 53,762 \text{ metre kilos.}$$

[††] Lectures at Royal Institution, Lect. VI.

[‡‡] New Theory of Muscular Action, p. 23.

[§§] Carpenter's Physiology, p. 215.

[||||] It would take from 1000 to 1200 grammes of coal burned in a steam-engine to raise a man from the level of the sea to the top of Mont Blanc; but the same man could do this work in two days by the transformation of 198·4 grammes of dry muscle.

seem temerity in me to trespass upon the premises of so great and distinguished a master, were it not remembered that during that interval rapid strides had been made in organic chemistry, and especially, perhaps, in the direction of the aniline colours.

Although I will endeavour to confine myself as much as possible to the immediate subject of the lecture, it will be necessary to glance for a few moments at the history of aniline, the progenitor of nearly all the beautiful compounds you see around the table.

Aniline was discovered in the year 1826 by Unverdorben, who obtained it from the destructive distillation of indigo. A short time afterwards Runge and Fritsche observed that by the action of strong hydrate of potash upon the dye, aniline was eliminated in far greater quantity. Indigo in small fragments is heated in a retort with a strong solution of caustic potash, and in the distillate, which consists of many products, there is found a thin and nearly colourless fluid, having a specific gravity of 1·028, a peculiar but not disagreeable odour, and a pungent biting taste. When kept for some time, even in the dark and in stoppered bottles, it assumes a darker tint, and becomes ultimately a very dark brown. Unverdorhen called it "crystalline," Kunge "kyonal," and Fritsche "aniline."

This substance is a nitrogenised base, and is capable, when combined with acids, of forming most beautiful crystallised salts, nearly all of which have been carefully examined by Dr. Hofmann and other chemists.

There are many other sources besides indigo, from which aniline may be obtained. For commercial purposes it is always prepared from nitro-benzol, a substance derived from the action of nitric acid upon benzol,—

$$C_6H_6+NHNO_3=C_6H_5NO_2+H_2O.$$

Nitrobenzol when agitated with water, acetic acid, and iron yields aniline—

$$C_6H_5NO_2+6H=C_6H_7N+2H_2O.$$

Benzol, originally discovered by Mr. Faraday in 1825, in his investigations upon the gaseous products from oils, was subsequently obtained by the decomposition of benzoic acid by means of caustic lime. Mr. Mansfield, however, succeeded in producing it in much larger quantities from coal-tar naphtha. When the lighter portions of this compound are distilled fractionally, until a constant boiling point of 180°F. is arrived at, the product consists of pure benzol, identical with the carbo-hydrogen obtained by Mr. Faraday.

From the earliest discovery of aniline it was noticed that certain oxidising agents when mixed with a solution of its salts produced a fine violet tint. Even in minute quantities, a few drops of hypochlorite of lime renders it purple. There is another test for aniline, which I will show you, and which, as far as I am aware, has not been observed previously. If the red gases obtained by the decomposition of nitric acid by starch or sugar be passed into an aqueous solution of aniline, the liquid speedily assumes a yellow colour, owing to the formation of a new base—azophenylamine—which is gradually precipitated as a bright yellow powder. It was not, however, until the year 1856 that aniline was applied to any great practical purpose, although from the beauty of its compounds and from its comparative accessibility, it had, from the time of its discovery, become a great favourite with chemists.

Mr. Perkin was the first who produced colour on an extensive scale from this base. He added a solution of bichromate of potash to a salt of aniline, and from the precipitate thereby produced he isolated a magnificent purple dye he termed "mauve," which at once became popular, and, indeed, at the time, almost universal. It may truly be said that this discovery has identified Mr. Perkin with the aniline colours, and that he will be always associated with one of the most striking and brilliant passages in the history of chemistry as applied to the industrial arts.

It cannot be supposed that such a discovery would be allowed to rest. A mine had been opened which chemists began to explore, and in such numbers and with such avidity and zeal as almost to lead us to anticipate that its riches will soon be exhausted. The action of numerous bodies upon aniline and its homologues were found to be productive of colour. Nitrate of silver, nitrate of mercury, chloride of mercury, chloride of tin, arsenic acid, iodine, and many others, when heated with the base, gave a rich crimson colour in more or less abundance; and although it would be impossible for me to enter into a disquisition on the comparative merits of these various methods for the production of colour, I trust to be able to produce magenta, although in a somewhat crude form, at this lecture table, and also to dye this tassel of silk from a solution of its salt. The reagent I will employ is iodine. A few crystals of this element are placed in a tube with about twice their weight of aniline. Heat is at once developed, and with the assistance of a higher temperature from the spirit-lamp, you will observe that in a few moments intense colour is developed. If a few drops are now poured into spirit, and this solution added to water, a fine rose-coloured tint will appear.

It may seem strange to those who have read Dr. Hofmann's beautiful researches upon the aniline substitution products, his chloraniline, bromaniline, iodaniline, and a multitude of others, that he had not observed this curious reaction; and this leads me to tell you *en passant*, for time will not allow me to dwell upon this interesting topic tonight, that aniline, when perfectly pure, does not yield any amount of colour with most of the reagents mentioned above—a most important fact discovered by Mr. Nicholson and Dr. Hofmann, and which has given rise to one of the most difficult questions which yet remain to be answered. I will simply say that it appears there must be a homologue of aniline present with that base to produce the colour you see before you, although that homologue *per se* will give no colour whatever.

The tintorial power of the salts of magenta is something marvellous. No dye that I have examined, whether from the animal, vegetable, or mineral world, can bear comparison for one moment with this crimson colour obtained from aniline. One grain in a million times its weight of water gives a pure red; in ten millions, a rose pink; in twenty millions, a decided blush; and even in fifty millions, with a white screen behind the vessel in which it is dissolved, an evident glow. Perhaps the most startling and graphic incident of this wonderful power is found in an account, which I presume to be authentic, of one of the passages of the *Great Eastern* from Liverpool to New York, some few years ago, when a hurricane swept over the Atlantic, rendering the mighty vessel powerless amid the mightier sea. After one terrific night it was observed that far around the vessel the waves seemed tinged as though with blood, faint and diluted in the distance, but deep, and crimson, and terrible in the immediate vicinity, while after every roll of the giant ship gushed forth anew a deep ensanguined flood. When the storm had somewhat abated, and search was made for the origin of this startling phenomenon, it was discovered that some tremendous billow had staved in part of the hold, and at the same time shattered some vessels containing magenta in a most concentrated form, which, sweeping over hatches and through port-holes, did, more truly than Banquo's blood on Macbeth's hand, "the multitudinous sea incarnidine."

Although the salts of magenta are possessed of such wonderful colouring power, the base itself is colourless; and it is remarkable that the union of base and acid for the formation of a salt does not appear to take place, in dilute solutions, in the cold. We have here two vessels, one of hot the other of cold water; an equal quantity of magenta base is added to each, and also an equal amount of dilute sulphuric acid. You will observe that in the hot solution colour is instantaneously developed, while in the cold there is no change; but if hot water be added to the latter so as to raise the temperature the colour at once becomes apparent. You may judge, therefore, that, having free acid in a solution of base without production of colour, it is possible to have free alkali in a coloured solution of a salt of the base without destroying its tint. Such is the case: to these two solutions of acetate of magenta, one hot and the other cold, is added equal quantities of caustic soda; the hot liquid is rendered colourless, the cold retains its original hue.

Ethyl-rosaniline, a substitution product of rosaniline, discovered by Dr. Hofmann, and which gives a most beautiful shade of violet when in solution, is capable of affording most remarkable manifestations. This dark violet liquid, on the addition of sulphuric acid, becomes colourless; on adding ammonia the purple is restored. If hydrochloric acid is employed in small quantities the liquid changes to blue; if in larger quantities, to a brilliant green; but if this green liquid be thrown into water you will observe that the original violet returns.

When aniline is heated with salts of rosaniline, purple and blue compounds are produced. The blue is perfectly insoluble in water, but soluble in alcohol, and its solution thrown in water imparts a brilliant tint, although probably the dye is only in a most minute state of division. If a tassel of wool or of silk be plunged into this liquid, you will observe that the colour disappears from the bath, and the fabric becomes dyed; it has acted like a sponge, or, perhaps, more properly speaking, like a filter, arresting in its passage through the water the finely disseminated particles. Mr. Nicholson patented a method for obtaining a beautiful blue dye soluble in water, which consisted in heating the phenyl blue with strong sulphuric acid. This compound, however, though most advantageous for silks, refuses to impart its colour to wool, and we have before us the curious phenomena of wool and silk in the same vessel, the one of a bright azure tint, the other perfectly untouched. The effect is still more striking upon cotton. We have here the letters "R. I.," in honour of the Royal Institution, worked in silk upon a cotton ground; after dipping it for a few moments in this bath, you will see that the letters are blue and the cotton is unchanged.

There is another colour I must mention, aniline green, produced by the action of aldehyde upon acid solutions of rosaniline. This is one of the most charming colours yet discovered; the green is perfect, and you have only to compare the artificial greens made by the mixture of blues and yellows with this extraordinary dye to see the wonderful difference they present.

I have prepared a little conceit here, which may be called puerile by some, yet which I cannot help feeling is full of instruction. You are aware that the base magenta or rosaniline is colourless. Such is the case with the majority of the aniline colours. We were taught in the catechisms of childhood that there are seven primitive colours—violet, indigo, blue, green, yellow, orange, and red.

Aniline consists of seven letters, and up to the present time we have from this wonderful base obtained seven colours. On this white board the letters of aniline are written in the colourless bases, and if our experiment succeed you will find that upon sprinkling the board with acetic acid and spirit, the A will be violet, the N indigo, the I blue, the L green, the I yellow, the N orange, and the E red, making aniline speak to us in the language of its gorgeous offspring.

I am indebted to my kind friends Messrs. Simpson, Maule, and Nicholson for the beautiful specimens of dye, many of a most costly and magnificent description, which you see before you; and to Messrs. Hands, Son, and Co., of Coventry, for the splendid array of silks so kindly furnished me to illustrate my lecture.

ACADEMY OF SCIENCES.

May 8, 1865.

M. Em. Martin contributed the second part of his memoir entitled "*An Electro-Chemical Study of the Really Simple Bodies, Ponderable and Imponderable,*" devoting this part to an explanation of the phenomena of combustion, and of the pile. The simplest case of combustion, according to the author, is that of a mixture of hydrogen and oxygen, which produces water and heat, and which, according to the theory we noticed the week before last, is explained by the following equation:—

$$\mathrm{HEl} + \mathrm{OEt} = \mathrm{HO} + \mathrm{C}^*.$$

The two imponderables combine to form caloric, which is produced with sufficient intensity to become luminous before it combines with the water. Carbon hold two atoms of electrile, is $\mathrm{C,El_2}$. When it is once burnt in oxygen, it forms carbonic oxide $\mathrm{CO,El}$; burnt a second time with the same quantity of oxygen, it becomes $\mathrm{CO_2}$, in which the two atoms of electrile are replaced by two atoms of oxygen. So with sulphur and the metals.

The action of the battery is a modified combustion in which the two imponderables are kept apart, and sent along different wires.

MM. Friedel and Crafts communicated their paper "*On Silicium-Methyl and Methyl-Silicic Ethers.*" We announced the formation of these bodies last week. The process by which they are obtained is very simple. Chloride of silicium may be added to a mixture of zinc and iodide of methyl and the mixture heated to 200°. The tube or digester must be allowed to cool before it is opened, as the gas appears to be very poisonous. Rectified from potash, and then dried with chloride of calcium, silicium methyl is a limpid liquid, boiling at 30°, which burns with a luminous flame, scattering white fumes of silica. The composition is $\text{Si}4\text{ƟH}_3$; vapour density found 3·058, calculated 3·045. The authors remark the great difference in the boiling points of silicium ethyl, and methyl. The former boils at 152·5 or 122° above the latter, more than 30° for the increase of $\text{Ꞓ}\mathrm{H_2}$. Pure silicate of methyl can only be prepared from pure wood spirit. This the author procured from oxalate of methyl. Silicate of methyl, $\text{Si}4\text{Ɵ}\mathrm{H_3},\text{Ɵ}_4$ is a limpid body, having an agreeable ethereal odour, somewhat soluble in water, silica only depositing after a time in the gelatinous state. It boils at 120° to 122°. When the methylic alcohol contains a proper proportion of water instead of nominal methyl-silicic ether, a hexamethylic disilicate $\text{Si}_2 6\text{Ꞓ}\mathrm{H_3},\mathrm{O_7}$ is obtained, boiling at 201° to 202·5°, and resembling the normal silicate.

NOTICES OF BOOKS.

Annalen der Chemie und Pharmacie. Supplementary Volume. Third Number.

This extra number of the *Annalen* is principally occupied with Kopp's *Researches on the Specific Heats of Solid Bodies*, an abstract of which we published in our ninth and tenth volumes. There is, besides, a paper by Linnermann "*On the Behaviour of Acrolein towards Hydrochloric Acid and Zinc.*" In a former paper the author showed that in this reaction allyl and propyl alcohols, and a third body, which he left undetermined, were formed. He now shows that this third body is *acro-pinakon.* Thus we have three hydrogenated bodies formed from acrolein.

$$1.\ \text{Ꞓ}_3\mathrm{H}_4\text{Ɵ} + \mathrm{H}_2 = \underbrace{\text{Ꞓ}_3\mathrm{H}_6\text{Ɵ}}_{\text{Allyl alcohol.}}.$$

$$2.\ \text{Ꞓ}_3\mathrm{H}_4\text{Ɵ} + 2\,\mathrm{H}_2 = \underbrace{\text{Ɵ}_3\mathrm{H}_8\text{Ɵ}}_{\text{Propyl alcohol.}}.$$

$$3.\ 2\text{Ɵ}_3\mathrm{H}_4\text{Ɵ} + \mathrm{H}_2 = \underbrace{\text{Ɵ}_6\mathrm{H}_{10}\text{Ɵ}_2}_{\text{Acro-pinakon.}}.$$

The same author has also a paper "*On Pinakon,*" the typical pinakon obtained by the action of sodium on acetone. This body he shows to exist in two modifications, a solid and a liquid form, as does Benz-pinakon likewise.

We have also a paper "*On Some Derivatives of Pyromucic Acid,*" by H. Schelmz and F. Beilstein, and a paper by Hugo Schiff, "*On a New Series of Organic Diamines.*"

Annalen der Chemie und Pharmacie. April, 1865.

The first paper is by Dr. Carl Blas, "*On the Composition of the Etherial Oil of Laurel Berries.*" The author undertook his researches to confirm the results of Dr. Gladstone, who found pimentic acid in laurel oil. Dr. Blas found none in the specimens he examined, but obtained a product which he identified as laurinic acid.

In a paper "*On the Metamorphoses of Mustard Oil,*" Dr. Oeser states that by treating the oil with hydrochloric acid and zinc, he obtained *allylamin,* Ꞓ_3H_7N, a colourless liquid with strongly ammoniacal smell, provoking tears and sneezing, tasting acrid, boiling at 58° C., dissolving in water in all proportions, giving a strongly alkaline solution, which behaves like ammonia.

A "*Contribution to the Analytical Knowledge of Thallium*" is by M. Hebberling, who gives the reactions of several salts of the protoxide of thallium, and also of the sesquichloride and terchloride.

A paper "*On the Chemical Nature of the Brain Substance,*" by Oscar Liebreich, describes the method of separating, and the properties of, a crystalline body to which the author assigns the formula $\text{Ꞓ}_{116}H_{241}N_4\Theta_{22}P$, and which he names *Protagon.* This paper will no doubt attract much attention from physiological chemists.

A paper "*On the Appearance of Xanthin in the Urine,*" by Dr. G. Durr, shows how the Doctor, after bathing in natural sulphuretted waters, found xanthin in his urine, and also in the urine of a patient who had had strong sulphur ointment rubbed into his skin, but not after taking milk of sulphur into his stomach. The paper contains a simple process for detecting xanthin in urine. This fluid is precipitated with caustic baryta, the filtrate is carefully neutralised, and then a solution of corrosive sublimate added; a white flocculent precipitate shows the presence of xanthin.

A note "*On the Action of Hydrochloric Acid on Zinc Amid,*" by D. H. Peltzer, shows that this action results in the formation of double salt of chloride of zinc and chloride of ammonium. The author adds that an attempt he made to form mercuramid by passing ammoniacal gas into mercuric ethyl did not succeed.

The next is a paper by Limpricht "*On the Products Arising from the Action of Chloride of Phosphorus on Chloride of Benzoyl,*" which is followed by a communication by Schwanert "*On a Decomposition Product of Thiofurfol.*"

A note by Fleitmann "*On a Method of Preparing Oxygen,*" shows that when a strong solution of chloride of lime is gently heated with only a trace of freshly prepared peroxide of cobalt, a stream of oxygen is evolved and chloride of calcium is formed. The evolution of the gas is very regular when the mixture is heated to 70° or 80°. All the oxygen is given off, no chlorine acid being formed. The point most to be attended is to use a perfectly clear solution of chloride of lime; a milky or thick solution froths. We shall give the whole of this paper in an early number.

A paper of much interest by L. Carius, entitled "*Researches on Sugar, and Sugar-Resembling Bodies,*" describes the method of forming Propyl-phycit, a body presenting chemically a close analogy to sugar.

The remaining papers in this number have already been noticed or published at length in our pages.

Poggendorff's Annalen der Physik und der Chemie. No. 3. 1865.

The number of the *Annalen* contains several learned and valuable papers, of which we transcribe the titles, of those, at least, which first appear in this number. "*On the Dispersion of Light in Gases,* by Dr. Kettler. "*On the Affinities of Undecomposed Bodies,*" by P. Kremers; an ingenious paper, in which the author gives a fanciful arrangement of the elements of no practical value. "*On the Freezing of Water and Hail,*" by Dr. Berger, which gives some original ideas on the formation of hailstones. "*On a Hydrophan found in Hungary,*" a porous stone which the author employed in some diffusion experiments, by G. Reusch. "*On a Peculiar Structure of Beryl,*" by Dr. Plaffs. "*On the Velocity of Sound,*" a learned and important paper by Schröder van der Kolk. "*On Fluorescence,*" by Professor Pisko. "*On the Difference in Heat Radiating from Rough and Smooth Surfaces,*" by Magnus. "*On a Polarization Battery; a New Apparatus for Developing a Continuous Current of Great Tension by Means of Simple Elements,*" by Professor Thomsen, of Copenhagen. This battery would seem well worthy the attention of telegraphists, but a description would be unintelligible without the accompanying drawing. The remaining papers are "*On some Researches to Establish the Identity of Light and Electricity,*" by H. Wild, and "*On the Occurrence of Cobalt and Nickel in the Complex Mineral known in Germany as Fahlerz,*" by Dr. Higer. The mineral contains so many metals that the author's analytical process is of some interest, and we may return to it.

Journal für Praktische Chemie. No. 3, 1865.

In this number we find the first part of a long and valuable paper by the late Dr. Heldt, entitled "*Studies on Cements.*" We may refer to this paper again, when the paper is concluded.

A contribution to the knowledge of the "*So-called Xanthocobalt Compounds,*" by C. D. Braun, criticises the formulæ assigned by Gibbs and Genth to those compounds, and gives formulæ founded on the author's own results. We must refer those interested in these bodies to the original paper, which defies condensation.

A short notice "*On the Development of Sulphuretted Hydrogen,*" by L. C. Levoir, informs us that when sulphide of iron is no longer attacked by sulphuric acid in consequence of its having become covered with a coating of a sort of basic oxide salt, it may be, so to say, revived by washing it with a strong solution of caustic alkali.

Magnesium. London: Pitman. 1865.

This little tract contains a very good account of the discovery, present mode of manufacture, and uses of the metal magnesium.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

1098. E. Smith and C. Sieberg, Glasgow, "Improvements in obtaining violet colouring matters."—Petition recorded, April 20, 1865.

1140. W. E. Gedge, Wellington Street, Strand, "Improved apparatus for administering nourishment to the sick or infirm." A communication from B. Mallet, Paris. —April 24, 1865.

1154. J. N. Brown, Handsworth, and T. D. Clare, Birmingham, "Improvements in paints or compositions for coating and preserving metallic and other substances from oxidation and decay."—April 25, 1865.

1173. G. T. Bousfield, Brixton, "The manufacture of a new resinous gum or balsam." A communication from B. H. Dods, Melbourne, Victoria.—April 26, 1865.

1183. W. Balk, Emmerberg, Hanover, "Improvements in furnaces used for smelting and melting iron and other metals."—April 27, 1865.

1193. R. Ferrie, J. Murray, and A. Wilson, Paisley, "Improvements in dyeing yarns."

1198. T. White, Camden Town, "Improvements in apparatus employed in the reburning animal charcoal."—April 29, 1865.

Notices to Proceed.

3256. T. Richardson, Newcastle-upon-Tyne, "Improvements in the manufacture of manures."—Petition recorded December 31, 1864.

3. M. R. Leverson, Bishopsgate Street Within, "An improved method of treating apatite and other mineral phosphates."—A communication from J. Oliver, Estramadura, Spain.

5. J. F. Parker and J. Tanner, Birmingham, "Improvements in the manufacture of oxygen gas, and in treating and economising the residual products of the said manufacture."

9. R. Irvine, Musselburgh, N. B., "Improvements in treating the pitch obtained in, or resulting from the distillation of palm oil and other fats in candle-making."—January 2, 1865.

40. J. E. Vigoulete, Nelson Square, Peckham, "Improvements in the treatment of carbonaceous minerals, and in apparatus for preparing agglomerated fuel."

50. T. Richardson, Newcastle-upon-Tyne, and M. D. Rücker, Leadenhall Street, "Improvements in treating guano."—January 9, 1865.

73. S. S. Brown, Runcorn, "Certain improvements in the manufacture of lint."

80. W. Clarke, Chancery Lane, "Improvements in preparing or treating wood and other vegetable fibrous materials for the manufacture of pulp for paper."—A communication from Z. Orioli, A. A. Fredet, and P. A. H. Matussiere, Paris.—January 10, 1865.

140. R. A. Brooman, Fleet Street, "Improvements in treating phosphates of lime and salts of potass and soda, in order to fit them for agricultural uses."—A communication from G. Ville, Paris.—Jan. 17, 1865.

538. P. A. le Comte de Fontaine Moreau, Rue de la Fidelité, Paris, "Certain improvements in the treatment of madder and the products obtained therefrom."—A communication from J. Pernod, Avignon, France.—Feb. 25, 1865.

CORRESPONDENCE.

Continental Science.

Paris, May 15.

In the absence of any general chemical information, I may pick up a few facts in physiological chemistry which have been brought forward lately, and which I see you have not noticed. The first I may quote are the experiments of MM. Estor and Saintpierre on the seat of respiratory combustion. Where is [illegible] oxygen which is taken up by the blood in the lungs used up? In the general torrent of the circulation, the authors state; and by an examination of the blood of the carotid, renal, splenic, and crural arteries, they have shown that the further you go from the heart for the blood the less oxygen you find in it. In the arteries they state that only direct oxidation takes place in consequence of the absorption of the gas, and indirect oxidation from the splitting up of compounds. In the capillary and venous systems, however, the oxidation proceeds to the complete destruction of the compounds.

Dr. Demarquay has ascertained some curious facts by injecting sulphuretted hydrogen into the cellular tissue. He shows that the gas is quickly absorbed, and in a very short time is eliminated unchanged from the lungs, and may be detected by putting a piece of lead paper under the nose of the animal. The gas, however, cannot be detected in the blood by lead paper, which would indicate that it becomes in some way combined. When a small dose only is injected the elimination is slow, and inflammation of the bronchi and trachea is observed; but with a large dose the animal is quickly killed, and active congestion is observed.

At the last meeting of the Academy M. C. H. Deville presented a French translation of Dr. Percy's "Metallurgy." It has been made by two engineers, MM. Petitgand and Rouna, who have added special information from French sources.

The epidemic in Savoy still attracts some attention. General Morin states that there can be no resemblance between this disorder and the Russian fever, for in St. Petersburg they carefully avoid the use of iron stoves. In connection with the same subject, and the notion that the disease results from the presence of carbonic oxide in the air, M. C. H. Deville reminded the Academy that his brother had shown that red-hot cast iron allowed gases to pass freely.

The Mysterious Case of Poisoning at Dawlish.

To the Editor of the Chemical News.

Sir,—I have only just succeeded in obtaining samples of Simpson's rat poison from Messrs. Balkwill and Son, of Plymouth, who appear to be the only agents for this article in the West of England, as I have failed in getting it in most of the chief towns, even Exeter and Bristol; most of the druggists of whom I have inquired informing me that it is very seldom found in the trade. I have also analysed it, and find that the packets contain a very varied, irregular quantity of material; from seven and a-half to thirteen and a-half grains — four packets containing forty-one and a-half grains, giving an average of a little more than ten grains for each powder, if all equally mixed and properly weighed and divided. The mixture consists of arsenious acid, potato-starch coloured by smalts, and flavoured or scented with some essential oil, probably oil of rhodium. I found ten grains to contain four grains of arsenious acid.

It is, therefore, certain that Mrs. Williams had arsenious acid in her possession, and that she must have taken from six to eight grains, as two empty packets were found by the police in her bed-room. This is a quantity sufficient to kill, but requiring more time probably than she liked; thus accounting for the opening of the third packet.

I greatly regret that there was no opportunity given me of examining the saliva for strychnia, as that would have determined the question whether that poison had also been taken into the mouth. Mrs. Williams had been buried in the interval of the adjournment of the inquest, and I never saw the handkerchief.

It is probable, therefore, that Mrs. Williams purchased all these rat and vermin poisons at Plymouth on her way up to Dawlish from Devonport; and the tracing of the arsenic into her own possession is satisfactory to all parties, as the matter is now fully explained, and all other theories must for ever be set at rest.

I am, &c. W. Bird Herapath.

Toxicological and Micro-Chemical
Laboratory, Old Market Street, Bristol.

Royal Institution.—The following are the arrangements for the ensuing week:—Tuesday, May 23, at 4 o'clock, Professor Frankland "On Organic Chemistry." Thursday, May 25, at 4 o'clock, Professor Frankland, "On Organic Chemistry." Friday, May 26, at 8 o'clock, H. Bence Jones, M.D., F.R.S., "On the Determination by the Spectrum Analysis of the Rate of Passage of Crystalloid Substances into and out of the Tissues of the Living Body." Saturday, May 27, at 4 o'clock, Alexander Herschel, Esq., "On Meteorology."

MISCELLANEOUS.

Pharmaceutical Society's Conversazione.—On Tuesday evening the annual *conversazione* took place. It was, as usual, very numerously attended by members of the medical profession as well as pharmaceutists. A number of interesting and beautiful objects were distributed about the rooms, and gave much pleasure to the visitors. Mr. Stewart Harrison's self-acting preserver valve, for the extinguishing of fires, was explained and shown in operation, and Lenoir's patent prize medal gas-engine, of half-horse power, was at work during the evening. Carre's ammonia ice-making machine was also in operation during the evening. An improved dispensing counter (a very complete and convenient arrangement), designed by Mr. Joseph Ince. Specimens illustrating the manufacture of aniline dyes, including a set of products, with their proportions, from the common coal yielding the tar to the solid dye; also specimens of silk and wool dyed of various colours. Some of the dyes were beautifully crystallised, and of great value, from Messrs. Simpson, Maule, and Nicholson. (These specimens were illuminated with the magnesium light with beautiful effect.) Specimens of pure crystallised carbolic and picric acids, dyeing materials obtained from this source, and dyed silk illustrating the colours produced, from Messrs. Crace Calvert and Co. Specimens illustrating the manufacture of iodine and other products from seaweed, by Stanford's process, as carried out by the British Seaweed Company (Limited), from Mr. E. C. C. Stanford. Specimens of new organic polarising compounds containing iodine, described at the last meeting of the Chemical Society, from Mr. W. A. Tilden. Large platinum still, of about 100 gallons capacity, and of the value of 2000*l.*, such as is used in the manufacture of oil of vitriol; fine specimens of pure distilled magnesium, a platinum pyrometer, small platinum still, specimens of gold and its compounds, &c., &c., from Messrs. Johnson and Matthey, who also exhibited the magnesium light in the lecture theatre. A variety of philosophical apparatus, from Mr. John Browning, 179, Strand, including the following:—A new aneroid barometer, showing a movement of three feet for one inch of the mercurial barometer; the Herschel-Browning spectroscope, arranged for observing the spectra of the stars; star spectroscopes as used by Huggins; large model spectroscope with eight prisms; five-guinea spectroscope; objects shown with spectroscopes; micrometric apparatus in aluminium, &c. Self-acting electrical alarum, for giving notice of the escape of coal-gas, from Mr. Broughton. Berthon's improved telescope stand, and apparatus for polarised light, from Messrs. Horne, Thornwaite, and Co. Mercury pump with vacuum tube and induction coil, showing stratified electrical discharges in vacuo, by Mr. Ladd. Improved ophthalmoscope and microscopes, from Messrs. Smith and Beck. Unique collection of statuettes in amber, from Dr. Attfield. Oil-lamp furnace, from Mr. Griffin. Asteroscope, stereoscopes, microscopes, new photographic manipulating apparatus, from Messrs. Murray and Heath. Improved microscope condenser and microscopes, from Mr. Highley. Electro-magnetic engine (in motion), and other philosophical apparatus, from Mr. How. Dr. Maddox's microphotographs, manufactured by Mr. How, were shown in the secretary's office during the evening by Mr. Jones. Minerals and fossils, from Mr. Gregory. Specimens of dried ferns and seaweeds, from Mr. Jardine. Busts, pictures, prints, and antiquities, from Messrs. Hill, Bird, Butler, Campkin, Vokins, and Bremridge. Patent flexible diaphragm for the preservation of liquids liable to be injured by exposure to the atmosphere, and patent elastic valve, from Mr. S. Bourne. Simple needle telegraph, from Mr. T. Boverton Redwood.

Select Committee on Pharmacy Bills.—The Select Committee of the House of Commons commenced its sittings on Thursday last. On that day Dr. A. S. Taylor and Mr. Simon were examined. The evidence of the former was mainly in support of a clause restricting the sale of the more dangerous poisons. Mr. Simon's evidence was to the same effect. In the course of his examination he said that he could not see that an examination as to ability was of so much importance, because no Act would do away with carelessness. He did not believe that ignorance could be imputed to those who made mistakes in retailing medicines or compounding prescriptions. At the same time he advocated a high class education for dispensers. As soon as the evidence is printed, we shall return to the subject.

Direct Formation of Polychromatic Aniline.—This is the subject of a Belgian patent by M. Rave. He takes five parts of commercial hydrochloric acid and one part of colourless aniline, mixes the two, allows the mixture to cool, and then stirs in one part of peroxide of manganese and applies a great heat. When the mixture has taken a greenish-blue tint, it is ready for use. The peroxide of manganese in this part of the process may be replaced by other oxidising agents. The inventor next prepares a solution of chloride of chromium by dissolving one part of bichromate of potash in five parts of hydrochloric acid. In dyeing, the inventor first pours into the bath a variable quantity of the polychromatic aniline, according to the shade of colour required, immerses the wool, and applies heat. The wool is then withdrawn and placed in a bath with a small quantity of the chloride of chromium, whereupon the colour darkens, and an equal shade is produced.

Sorel's Cement for Stopping Teeth.—The author prepares a light oxide of zinc by moistening the ordinary oxide with nitric acid, and then igniting it. Oxide so prepared he makes into a soft paste with a solution of chloride of zinc having a specific gravity 1·9 or 2·0. The soft mass in a few minutes acquires great hardness, which it preserves for many years. To imitate the colour of the teeth the mixture may be made grey with the least trace of carbon; it is sufficient to hold the pestle with which the mixture is made over the gas for a moment. If a yellow tint is required, a trace of sulphide of cadmium may be employed.—*Neues Repertorium*, bd. xiii., s. 552.

The Reciprocal Hygroscopicity of Chloride of Calcium and Sulphuric Acid.—Gotz placed weighed quantities of these two bodies in separate vessels and left them side by side in a close tube for several months. In one experiment he used quite dry, and in another moist chloride of calcium. In the former case the two bodies only removed some moisture from the air; in the second the sulphuric acid removed nearly two equivalents of water from the chloride of calcium. The author concludes that solution of chloride of calcium containing 73·1 $CaCl$ and 26·9 HO, and sulphuric acid with 74·34 SO, and 25·66 HO are equal in their desiccating action. He remarked that after exposure together a trace of sulphuric acid is to be found in the chloride of calcium, which he ascribes to the tension of the hydrated acid. [Was the chloride pure?]—*Buchner's Repert. für Pharm.*, Bd. 13, 3, s. 104.

ANSWERS TO CORRESPONDENTS.

W. M. B.—The patent, we believe, is still valid.

Phenylamine.—No important industrial application has yet been found for naphthaline. The dyes have failed for want of brilliancy.

D. H. J.—A comparison of the tinctorial value of the various dyes with some of known purity is the best plan for ascertaining their commercial value.

M. W.—We are expecting the article from the author.

Cotton Seed Oil.—A correspondent wishes to know a test for this oi when used as an adulterant.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Contributions to the History of the Metals in Cerite and Gadolinite, by M. Marc Delafontaine.*

(Continued from page 174.)

II. Terbia and Yttria.—The earths remaining after the extraction of erbia, as directed in a former memoir (*ante*, p. 173) still contain a small quantity of erbia, from which they should be freed as much as possible. This is effected by a new series of partial precipitations, followed by methodical solutions in a diluted acid, and finally by the use of potash. This method is not perfectly strict, because erbico-potassic sulphate is slightly soluble in a liquid containing sulphate of potash; however, the proportion of erbia thus remaining in the mixture may be reduced to three or four thousandths.

I wished to substitute, for the precipitations by binoxalate of potash, the process recently proposed by MM. Deville and Damour for the relative estimation of the lanthanium and didymium contained in parisite.†. By exactly following the directions of these clever chemists I obtained, on the one hand, erbia, with a small quantity of its congeners, in the form of an insoluble basic nitrate, while the greater part of the yttria and terbia remain in solution. After having washed the subnitrate until it began to pass through the filter, I calcined it, and transformed it into double oxalate; this I treated by water acidulated with a fifth of sulphuric acid, which dissolved the two other bases, leaving erbia in a sufficiently pure state. The results thus obtained are perhaps less exact than those obtained by the old method, but there is, on the other hand, a great saving of time.

Yttria purified by one or the other of these methods, and re-dissolved in an acid, gives, with binoxalate of potash, precipitates variably soluble in diluted sulphuric acid; the most soluble contain yttria, the others terbia. Roughly separated in this way, then separately dissolved in and again partially precipitated, &c., these two earths may after a time be obtained sufficiently free from each other to allow the study of their distinctive characteristics.

Hydrated terbia forms a white gelatinous precipitate, remaining in this state during desiccation, but becoming yellow after being long calcined. In the anhydrous state, and according to the process by which it has been prepared, this earth offers the same differences of colour as does erbia, but only in the lighter tints. This colour must belong to the terbia itself; the presence of the trace of erbia, from which it is almost impossible to free it, is insufficient to account for the colour.

Calcined for some time at a white heat, or better, heated to a dull red in a current of pure dry hydrogen, terbia assumes, like erbia, a milk-white colour; the quantity of water produced in the latter case is barely appreciable. Its salts have always an amethyst-rose tint, which generally remains after solution, and is found in a less degree in the solid salts of erbia, and still less in those of yttria.

Diluted terbic nitrate is rose-coloured; it becomes darker and darker while concentrating, but without approaching violet, as does didymium. Heated slowly and carefully it loses all its water, fusing into a glass, which preserves its colour, and finally decomposes towards 500°, leaving a basic salt, from which a high temperature expels all the acid.

If not in too dilute solution the salts of terbia show, in the spectroscope, at least two absorption rays of equal intensity; one in the yellow part, near D, and the other in the green; they coincide with two bands of didymium; but when equal in concentration they are narrower.

Even after exposure to great heat terbia combines readily with acids, forming compounds with a sweet and astringent flavour; this base is more energetic than oxide of didymium; it expels ammonia from its salts even when cold, but especially when hot.

There is, to my knowledge, no other method for ascertaining to what extent terbia is freed from yttria; but if we concentrate very slowly, with gentle heat, a solution of yttriferous terbic sulphate acidulated with sulphuric acid, the crystals successively deposited have a smaller and smaller atomic weight, until finally they consist only of nearly pure sulphate of yttria. Starting with this fact, I have described, and considered as of the terbia type, that of which the sulphate gives, by crystallisation in three portions, products identical in composition.

More recent experiments have shown me that the atomic weight of terbia should be given as lower than 571, which number I deduced from my previous analyses; it is, however, greater than that of yttria.

In colour terbia resembles pure ceroso-ceric oxide; but is distinguished from it by its ready solubility in even diluted acids, its reactions with the blow-pipe, the colour of its salts, its atomic weight, and finally by its absorption spectrum.

Terbic salts resemble those of didymium in their colour and their dark lines; they are distinguished from the didymium salts by the colour and the equivalent of their base, and by the absence of the seven lines and bands characteristic of didymium.

Chemically terbia may easily be confounded with erbia, but the spectra of these two earths are very different.

In short, I believe I may consider the existence of terbia as established; its composition deduced from the isomorphism of its sulphate with that of didymium will then be represented by TrO, terbium should have for symbol Tr, and not Te (on account of tellurium), as it is sometimes erroneously given.

In Mosander's opinion terbia should be white, but it seems to have always been obtained yellow, and he also holds its distinctive characteristic to be the property of efflorescing at +50°C. possessed by its sulphate. I do not agree with this; terbic sulphate does not appear to me more efflorescent than that of yttria. Perhaps we did not experiment upon salts of the same degree of hydration; this appears to me all the more probable from the fact that I once obtained some indistinct crystals falling into powder on the filter paper, and corresponding in composition to the formula $TrO.SO_3 + 3aq$. As I have said before, M. Berlin considers terbia as a simple mixture of erbia and yttria; the properties I have described seem to me incompatible with this opinion. M. Bahr seems still undecided as to the existence or non-existence of terbia.

Yttria.—In the order of basic energy this earth is the first of the group. From having imperfectly purified it, I described it in my first memoir as of a very light yellow colour. This is erroneous; whether anhydrous or hydrated,‡ yttria is perfectly white; like the other two, it carbonates easily, decomposes ammoniacal salts, combines with all acids, with disengagement of heat if they

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* *Bibliothèque Universelle et Revue Suisse*, xxii., 30 65.

† *Comptes Rendus*, lix. 270. Chemical News, vol. x., p. 230.

‡ M. Popp is wrong in regarding the whiteness of yttria as accidental, and attributing it to a mixture of potash or lime.

are concentrated, and gives syrupy solutions. Its solutions have not the property of showing the spectrum of absorption.

Its white colour can cause it to be confounded only with lanthanic oxide; these two bases are distinguished by their crystalline form and the centesimal composition of their simple sulphate; moreover, yttrico-potassic sulphate is soluble in pure water, and still more so in water containing sulphate of potash, which is not the case with the salt of lanthanium.

Estimation of Gadolinite Earths.—In the analysis of double salts with a fixed alkali base, and yttria (or erbia and terbia), the best method consists in precipitating the earth by caustic potash, with all the precautions recommended in Rose's "Chimie Analytique." If the salt is simple, or combined only with an ammoniacal salt, it is better to avoid heating and to replace the potash by oxalate of ammonia. The liquids should be as neutral as possible, on account of the solubility of earthy oxalates in diluted acids. The precipitate though light is easily collected and washed; it readily passes through the filter after water has been once or twice passed over it, but this inconvenience is obviated by the addition of a little ammoniacal nitrate or chloride. Calcination must be effected in an open crucible, because all the oxalates of this group leave carbides when decomposing out of contact with oxygen, as is shown by the blackness of their residue. When after a few minutes the earth becomes white or yellow, the cover is replaced and the crucible heated to expel the last traces of carbonic acid. In very exact researches it is necessary to eliminate the small excess of oxygen retained by the earth, to effect which a current of hydrogen must be passed in the usual way into the crucible, through a tube traversing the lid. The results obtained by this method are rigorously exact.

Having, as it appears to me, positively established the individual existence of the three earths of gadolinite, and thus confirmed the excellent results obtained by Mosander, it remains for me to make known several salts, the study of which is quickly achieved, and to determine more exactly the atomic weight of erbium, yttrium, and terbium. This must be the subject of some future memoir.

(To be continued.)

A New Method for Preparing Benzoic Acid, by MM. P. and E. DEPOULLY.[*]

THIS process is founded on the transformation of phtalic into benzoic acid.

The division of phtalic acid into benzoic and carbonic acids was foreseen by Gerhardt; when he placed phtalic acid and naphthaline in the benzoic series, he considered that this acid was to benzoic acid what oxalic is to formic acid. (Gerhardt, "Chimie Organique," iii., 413.)

M. Berthelot (Chimie Organique Fondée sur la Synthèse, i., 348), speaking of the complete division of phtalic acid into benzine and carbonic acid, expresses himself thus in a note:—"Were the decomposition arrested half way, benzoic acid would doubtless be produced."

M. Dusart has since, but without success, endeavoured to effect this division; but by distilling a mixture of phtalate of soda, oxalate and lime, he has obtained, among other products, small quantities of hydride of benzoil (*Comptes Rendus*, 1862, lv., 448).

We prepare phtalic acid by means of naphthaline, and we transform it into salt of lime.

We mix an equivalent of neutral phtalate of lime bicalcic phtalate, with an equivalent of hydrated lime, and maintain it for several hours at a temperature of from 330° to 350°, not allowing free access of the air.

The salt will then be entirely transformed into benzoate and carbonate of lime, according to the equation—

$$C_{16}H_4CaO_8 + CaO.HO = C_{14}H_5CaO_4 + 2CaO.CO_2.$$

We extract the benzoate of lime by water, concentrate the liquids, and precipitate the benzoic acid.

Solution of Some Metallic Oxides in Fused Caustic Alkalies,[†] *by M.* STANISLAS MEUNIER.

SMALL portions of binoxide of mercury thrown into potash, maintained in a state of fusion, dissolve with the greatest ease. The solution is accompanied by no gaseous disengagement, and it gives a colourless liquid if the materials are perfectly pure, more or less greenish if they are impure. The quantity of mercuric oxide which will dissolve in a given weight of potash is very considerable, but cannot be precisely determined. In proportion, in fact, to the concentration of the solution, its temperature rises, and oxide is abundantly disengaged; from that time any binoxide which is added only replaces that which is each moment destroyed. As the concentration increases, the mass acquires a yellow tinge, and takes the consistence of less and less fluid oil.

By cooling, the solution becomes coloured, and finally assumes a tint depending upon the conditions under which it is produced. Washing in cold water gives a powder corresponding in colour to the mass from which the powder proceeds, and the composition of which varies with the colour.

A constant product may be obtained by the following process:—Heat some potash in a silver capsule, and before it is quite fused, throw in a quantity of mercuric oxide too small to saturate the alkali. The oxide then gradually dissolves at a temperature below 400°. Soon, the whole of the potash being melted, the last particles of oxide disappear; when the heating must immediately cease, and the cooling be very slowly effected. Under these circumstances, the mass takes a violet-brown colour. When quite cool, treat it by a small quantity of water, just sufficient to dissolve the excess of potash, and a violet powder is thus obtained, mixed with a much lighter greenish grey powder, which, on account of its lightness, is easily separated by simple decantation. Then dry the two powders on porcelain; they constitute combinations of mercuric oxide and potash, the composition of which I have not yet accurately determined. Examined with the microscope, the violet compound seems to be formed for the most part of tawny red transparent crystals. The greenish compound is amorphous.

The violet body is decomposed, but not completely, by prolonged washing. After boiling four hours in distilled water, this body still contains an appreciable quantity of potash.

By reason of its instability certain precautions are necessary to separate the compound from potash. It is advisable, for instance, to wash it in anhydrous alcohol instead of water. Nevertheless, it is better to leave the potassic mass to deliquesce and to close the operation as soon as possible. The only drawback to this process is that it renders it difficult to separate completely the above-mentioned greenish compound.

If, instead of being slowly cooled, the solution of binoxide of mercury in potash is thrown drop by drop into

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[*] *Comptes Rendus*, lx., 456. 65.

[†] *Cosmos*, L., 353. 65.

cold water, a yellowish precipitate is produced, which might at first sight be mistaken for yellow oxide of mercury, but which, in spite of washing, always contains potash. In its properties it much resembles the greenish compound. It is also reproduced by maintaining the solution for a long time in fusion.

All these reactions take place equally with yellow oxide of mercury and with red oxide.

Fused caustic soda has, with respect to binoxide of mercury, the same solvent properties as potash. By operating with the above precautions a compound is obtained in the form of an orange-brown crystallised powder.

Protoxide of bismuth dissolves very readily in fused potash and soda.

It thus gives two compounds very rich in alkali, which I am now engaged in studying. They are in the form of a greyish white crystallised powder. Great precautions should be taken in preparing them, for, at a high temperature, in presence of melted alkalies, bismuth peroxidises very readily. I believe that bismuthates of potash and soda may be easily prepared in this way.

Oxide of cadmium also dissolves in fused potash and soda, giving grey and amorphous compounds, probably corresponding to alkaline zincates.

TECHNICAL CHEMISTRY.

Galibert's Respirators.

There are unhappily many occasions on which men have to enter a suffocating or poisonous atmosphere, and many fatal accidents have ensued. The apparatus we now describe has been devised to supply men so circumstanced either with a reservoir of pure air from which they can respire for a longer or shorter time, or to keep up a continuous supply by free communication with the external air. The former apparatus (Fig. 1) is adapted for firemen and others who may at times be required to enter and remain for a time in a suffocating atmosphere; and the latter (Fig. 2.) for well-sinkers, miners, or sewer-men who may be compelled to work for a long time in the presence of a poisonous gas. A complete idea of the apparatus will be given by the accompanying figures, assisted by the following description:—

It is composed of three parts,—first, a piece of horn, or ivory, of the form and dimensions of the human mouth when open, pierced with two holes; second, two caoutchouc tubes of a proper length, communicating with the holes in the piece of horn or ivory; and thirdly, a nose pincher for preventing respiration through the nose. The apparatus is used as follows:—The pincher being applied to the nose, the mouth-piece is placed in the mouth, where it is held by slight pressure of the teeth. The lips, by surrounding the mouth-piece, prevent communication between the chest and the air in which the operator is at work, so that he can only breathe the air brought by the tubes, the other ends of which are in the open air. The tongue acts the part of a valve, opening and closing alternately, the holes communicating with the tubes for inhaling and exhaling air. This alternate movement of the tongue is exceedingly easy, and is performed almost instinctively after a few minutes' practice. On placing the mouth-piece between his teeth, the operator closes the right hole with his tongue; he then draws air into his lungs by the left tube; he next moves the tongue, without pressing it, over the left hole, and then expires or breathes out vitiated air by the right tube. There are thus no mechanical parts in this apparatus; the lungs fulfil the functions of a suction and force-pump, and the tongue acts as a double valve. As smoke and gases affect the eyes, the inventor also provides special glasses, or even surrounds

Fig. 1.

Fig. 2.

the head with a hood. The india-rubber tubes, as we have said, are sometimes in communication with the external air, and sometimes with a reservoir, as in Fig. 1. It was this latter form of the apparatus which we saw used at the Polytechnic a week ago. Provided with it a man entered an apartment which had been extemporised by extending canvas over a wooden frame. In this chamber a mixture of cotton waste and nitre was ignited, generating a dense and suffocating smoke; a man was, however, able to remain in such an atmosphere without discomfort for twenty minutes, and so demonstrate the perfect adaptation of the apparatus for its purpose.

PHARMACY, TOXICOLOGY, &c.

Alleged Poisoning by Oil of Bitter Almonds.

A CASE of poisoning near Maidstone, which we find reported in the *Chemist and Druggist*, deserves some notice as of interest to toxicologists. A lady purchased, it is said, some essential oil of bitter almonds to scent pomatum, made use of some for the purpose, and left the bottle on the kitchen table, some time, it would appear, before the servants' dinner hour. The exact hour is not stated, but we may presume it was before the middle of the day. Finding the bottle on the table, the cook took it up and tasted its contents. She stated that she merely put the bottle to her lips, but did not swallow any of the contents. It tasted bitter, and she ate a piece of bread to take the taste out of her mouth. She saw the deceased (a page-boy, aged thirteen) take up the bottle and put it to his lips, and she took it away from him. The boy told her he did not swallow any of the contents. Shortly after this the servants had their dinner, and an hour afterwards the cook was taken ill, but the boy went about his work as usual. A medical man who was sent for found the cook unconscious; was told that she had swallowed some oil of bitter almonds, so he administered some brandy, and she soon rallied. At this time there was nothing the matter with the boy. The medical man on leaving the house after attending to the cook met the boy out with his master in the carriage. In the course of the evening the lad was taken ill, and the doctor was again sent for. He found the deceased insensible, almost pulseless, and his teeth so tightly closed that he had great difficulty in getting a piece of cork between them. Brandy was administered freely, but without success. He was carried upstairs about seven o'clock in the evening, and died at a quarter past eleven. At the inquest the medical man stated, "that he had no doubt the deceased died from the effects of having taken oil of almonds. If the boy had taken a larger quantity his stomach would have rejected it at once, and it might not then have got into his system. He should say the deceased and the cook must have taken a teaspoonful each." In the last words spoken by the boy he denied having swallowed any.

In a note to the report our contemporary says—"We have been informed that the poison was not genuine oil of almonds, but a factitious oil," and it must be quite clear to any one acquainted with the subject that the poison was not essential oil of bitter almonds. Everybody knows that the poison in this oil is prussic acid; and we believe we may state with truth that there is not a case on record in which the symptoms of poisoning by prussic acid have been delayed for the length of time which elapsed in this case. All the circumstances lead to the suspicion that the poison taken was *nitrobenzole*, the dangerous properties of which body are not sufficiently known. It may be, indeed, that this more dangerous poison was sold in innocence as oil of bitter almonds not containing prussic acid.

The case of this boy bears a considerable resemblance—so far, we ought to say, as we can gather from the report of the inquest—to the case of a lad who died from the effects of a few drops of nitrobenzole which he took by accident at a chemical manufactory. In that case four or five hours elapsed before the fatal symptoms came on, and the duration of the symptoms was about the same in each case.

In the interest of science we must hope that this case will receive further elucidation, both from the druggist who sold the poison and the medical man who attended the deceased.

PHYSICAL SCIENCE.

On the Construction of the Spectroscope, by LEWIS *M.* RUTHERFORD.

I KNOW of no good substitute for bisulphide of carbon as the dispersive agent in the spectroscope. Flint glass, besides being expensive when in larger masses and of good quality, possesses but half the dispersive power, and the specimens of the denser glass which I have seen tarnish so rapidly, and have so high an index of refraction, as to be practically useless. Having devoted much time to the construction and management of bisulphide of carbon prisms, it is quite possible that the results of my experience may be useful to those who may wish to fit up a spectroscope with such prisms, and perhaps I shall best attain the object by describing my own instrument.

The two principal telescopes are provided with objectives of 1·6 inches aperture and 19 inches focal length. The slit or collecting telescope has but one motion about a vertical axis at the side of the platform and just in front of the objective, enabling it to command all parts of the platform. The observing telescope has two motions—one about the central axis of the instrument, and the other about a second vertical axis, which, by means of a slide capable of being clamped, can be placed under the last surface of any prism on the platform; thus commanding by one motion the whole spectrum.

Before the slit is a prism for the comparison of different spectra, and the observing telescope is provided with eye-pieces of various powers. The first circuit consists of six prisms, which are of glass, faced with plates of glass, cemented with glue and molasses. These are each of about the angle of 60°, and present an aperture of 2·9 × 1·8 inches. The faces to receive the glass are carefully ground to a flat surface, and the glass quite thick and free from veins has been selected with reference to the flatness and parallelism of the sides.

Since, however, it is scarcely possible to find glass with parallel surfaces, care has been taken so to place the glass that the inclination of its faces is perpendicular to the axis of the prism. After grinding the prisms the bases were so adjusted by filing that the refracting surfaces are rigidly perpendicular to the plane of the platform. This once done removes all necessity for foot-screws, which complicate the prisms, and add to the expense.

The surface to be glazed was washed with an alkaline solution to remove all grease, and then in dilute nitric acid, finally washed in pure water, and allowed to dry spontaneously. After being warmed, the prisms were so placed that the surface to be glazed was uppermost, and in a horizontal position: the glass, having been cleaned after the manner of a plate for photographic purposes, also warmed, and both surfaces to be in contact, dusted with a fine camel's hair brush, was placed in position upon the prism, a hot and fluid mixture of glue and molasses was then applied with a fine brush around the edges of the glass, whereupon a uniform and very thin film of the cement was introduced between the glass and the prism by capilarity. The prism was left untouched until the cement had hardened so as to admit of being removed and placed glass downwards for at least a day, when the next surface was treated in like manner. After the expiration of another day, I generally put on another coat of cement, much thicker in consistency than the first. In five days more the prism was ready to be filled through an orifice in the top, to which is fitted a ground stopper, which is rendered perfectly tight by a little molasses. It may be thought that my description is needlessly particular, but I have mentioned nothing which experience has not shown to be necessary to the permanence or performance of the prism.

I soon discovered that after I had made a good prism its performance would be uncertain, and I finally traced the difficulty to a want of equal density in the bisulphide of carbon, and this peculiarity I have observed not only in the fluid of commerce, but quite as much so in that specially redistilled for the purpose. The fact of this unevenness of density is found in two ways. If a good prism, which, with a high power, refuses to define the soda line (a more stringest test than solar lines) is violently shaken, and then placed in position, it will, for a few minutes, define beautifully, but gradually settle into its former condition. By covering the aperture of the prism, except a small portion of the upper part, and bisecting the soda line with a spider's web in the eyepiece, all parts of the instrument being clamped, then covering all but the lower portion of the prism, it will be found that the soda line has been carried to a notable extent toward the violet end of the spectrum.

This want of homogeneity in the bisulphide of carbon is entirely different from the disturbance of density by thermal variations. It is a permanent feature of some specimens of the fluid, and is most observable when the prism has been longest at rest in equable temperature. I have one such prism filled nearly two years since, which defines beautifully for a short time after being well shaken, but soon returns to a poor condition. The difference between the indices of refraction of the upper and lower strata is quite a measurable quantity. My mode of overcoming this obstacle is to filter several pound bottles of the bisulphide of carbon into a long glass jar, having a faucet at the bottom and a ground stopper at the top. After remaining undisturbed two days the liquid arranges itself according to its density, and I fill the prisms from the faucet, being careful not to shake the jar. Careful and repeated measures give for the index of refraction of the soda line with the prism first filled from the bottom 1·62376, and with the sixth prism, filled with the fluid near the upper portion of the jar, 1·62137.

In order to obtain fine definition it is necessary that the prisms should be placed at the angle of least deviation for the ray under observation. To make the adjustment with several prisms, or to change it when made, is so barbarious and troublesome a task as almost to amount to a prohibition of the use of a powerful battery for practical and extended investigations. To remedy this evil I have devised and executed a mode by which I effect the adjustment of all the prisms by one motion of a milled head. Upon the glass plate which forms the platform of the instrument, and in the centre of the system, is cemented a brass plate, in a cavity of which revolves without shake a pinion provided at the top with a milled head. The prisms are all hinged together at the corners, and from the back of each projects at right angles a brass bar, provided with a slot, which embracing the revolving standard accurately, retains each prism in such a position that, whether nearer or more distant from the centre, its back is always perpendicular to the radius connecting it with the centre of the standard. The slot of the third prism is provided with teeth which gear into the pinion, so that by turning the milled head this prism is forced to approach or depart from the centre; but from the construction this cannot take place without imparting a similar motion to each of the other prisms, and thus at will their backs are made tangents to a larger or smaller circle, which is the adjustment sought.

This mechanism is capable of adjusting six or any smaller number of equi-angled prisms. The outer spiral, when more than six are used, must be adjusted by hand.—*American Jour. Science and Arts*, vol. xxxix., No. 116.

On a New Thermo-Element, by *M.* S. Marcus.

The author has given the following account of the properties and construction of his new thermo-element:—

1. The electro-motive force of one of the new elements is $\frac{1}{25}$th of that of Bunsen's element, and its resistance is equal to 0·4 of a metre of normal wire.
2. Six such elements can decompose acidulated water.
3. A battery of 125 elements disengaged in a minute 25 cubic centimetres of detonating gas. The decomposition took place under unfavourable circumstances, for the internal resistance was far greater than that of the interposed voltameter.
4. A platinum wire half a millimetre in thickness introduced into the circuit of the same wire is melted.
5. Thirty elements produce an electro-magnet of 150 pounds lifting force.
6. The current is produced by heating one of the junctions of the elements and cooling the second by water of the ordinary temperature.

To construct this battery it is necessary, on the one hand, to procure two electromotors suitable for a thermo-element, and, on the other, to have such an arrangement of the elements and of the means for heating and cooling as will ensure as favourable a result as possible. The former constituted the physical, the latter the constructive part of the problem.

In solving the first part of the problem, it was the author's endeavour—

a. To use such thermo-elements as are constructed of metals as far apart as possible in the thermo-electric series, and

b. Such as permit great differences of temperature without using ice, which is only practicable if the bars possess as high fusing points as possible.

c. The material of the bars must not be costly, and the bars themselves must be easily constructed.

d. The insulation used for the elements must be able to resist high temperatures, and must possess sufficient solidity and elasticity.

As neither the usual bismuth antimony couples nor any combination of the other simple metals satisfy these conditions, M. Marcus availed himself of the circumstance that alloys in the thermo-electric pile do not stand between the metals of which they consist, and was thereby led to the following alloys, which completely satisfy the above requirements:—

For the positive metal—

10 parts of copper,
6 " " zinc,
6 " " nickel.

An addition of one part of cobalt increases the electromotive force.

For the negative metal—

12 parts of antimony,
5 " " zinc,
1 part of bismuth.

By repeated remelting the electro-motive force of the alloy is increased.

Or he used a combination of argentane (known as alpacca from the Triestinghofer Metal Manufactory) with the above negative metal; or an alloy of

65 parts of copper,
31 " " zinc,

as positive metal, and an alloy of

12 parts of antimony,
5 " " zinc,

as negative metal.

The bars are not soldered together, but bound by means of screws.

The positive metal melts at about 1200° C., the negative at about 600° C.

As in this element it is only the heating of the positive metal which influences the development of electricity, the arrangement has been made that only this is heated, while the negative metal receives heat by conduction. By this arrangement it is possible to apply temperatures of even 600°, and consequently to attain greater differences of temperature.

An interesting illustration of the conversion of heat into electricity is the fact that the water which is used for cooling the second point of contact of the element becomes warm very slowly as long as the circuit is closed, but pretty rapidly if it is open.

The thermo-pile in question was constructed with a view to being used with a gas-flame. The individual elements consist of bars of unequal dimensions. The positive electrical bar is 7″ long, 7″ broad, and ½‴ thick; the negative electrical bar is 6″ long, 7″ broad, and 6‴ thick. Thirty-two such elements were screwed together, so that all positive bars were upon one and all negative on the other side, and thus had the form of a grating. The battery consists of two such gratings, which are screwed together in a roof shape, and are strengthened by an iron bar. As an insulator between the iron bar and the elements, mica was used. Besides this, the elements, where they came into contact with the cooling water, were coated with soluble glass. An earthen vessel filled with water was used for cooling the lower contact sides of the elements. The entire battery has a length of 2 feet, a breadth of 6 inches, and a height of 6 inches.

M. Marcus communicated further that he had constructed a furnace which was intended for 768 elements. They represent a Bunsen's zinc carbon battery of thirty elements, and consume per diem 240 pounds of coal.—*Sitzungsbericht der Akademie in Wien*, No. 8, 1865.—*Philosophical Mag.*, vol. xxix., No. 197.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, April 28.

"*On the Food of Man in relation to his Useful Work.*" By Lyon Playfair, C.B., LL.D., F.R.S.

(*Continued from page 235.*)

20. Nothing is better established in physiology than that muscular activity is dependent on a free supply of arterial blood to the muscles. When a ligature is applied to a large arterial trunk, the action of the voluntary muscles depending on that vessel is either wholly or partially arrested, at least until the collateral circulation is developed. Thus when the abdominal aorta is tied in animals, their hind legs can scarcely be dragged along (Segalus).[¶¶] Such experiments only prove that a free supply of arterial blood to the muscle, to promote its transformation and to restore its waste, is necessary for the production of muscular action. Anything that interferes with the oxidising influence of the blood upon the substance of the muscle affects the power of movement. In the cerulean disease, when venous and arterial blood become mixed, the patient shows both indisposition and inability for muscular exertion. Like difficulty is observed in the thin air of mountain tops, until the lungs become suited to it. Certain substances which retard the oxidation of phosphorus or phosphuretted hydrogen, even in the presence of oxygen (Graham), such as ether and chloroform, seem to act in a like way on the tissues of an animal, by arresting muscular effort. The proof that there is diminished oxidation in such cases is found in the presence of sugar in the urine. The wayward gait of the drunkard under the influence of alcohol is probably the result of a similar obstacle to change.

Gustav von Liebig[*] has demonstrated that the oxidation of tissue is quite essential to muscular irritability, which ceases when the access of oxygen is prevented, and is again manifested when it is supplied. Scelkow's[†] experiments on the gases of the blood are particularly interesting in this point of view. Arterial blood contains 17 vols. of oxygen, and is reduced to 8 vols. in coursing through a muscle at rest, and to between 1 and 2 vols. when the same muscle is in action, the volume of carbonic acid augmenting from 24 to 34½ at the same time. These experiments prove clearly that oxidation and contemporaneous production of carbonic acid attend the transformation of tissues, a fact which other physiologists had shown with less numerical precision formerly. Thus Matteucci,[‡] in confirming the fact that muscular contraction is dependent on the presence of oxygen, showed that the evolution of carbonic acid is proportional to the amount of contraction, a result which has been confirmed by Valentin.[§] We need scarcely adduce proofs that the oxidation and production of carbonic acid proceed simultaneously in the substance of the tissue and not in the blood, for as long as the muscle is contractile, after it has been cut off from the blood, the same changes go on. Again, in insects which have no true blood, carbonic acid is produced by muscular activity (Newport).[‖] Valentin[¶] observed that when muscular contraction takes place a greater volume of oxygen is absorbed than of carbonic acid evolved, a result to be expected when we know that hydrogen is oxidised and urea is formed. Helmholtz attempted to follow the changes in a contracting muscle, and found evidence of

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[¶¶] *Journ. de Phys.*, 1824.

[*] Inaugural Abhand. Giessen, 1853.

[†] *Sitz. Wiener Acad.* 1862.

[‡] *Comptes Rendus*, xlii. 648.

[§] *Müller's Archiv.* 1845. S. 72.

[‖] *Phil. Trans.* 1836.

[¶] *Archiv. fur Heilkunde*, xiv. 431.

increasing lactates, but could find no diminution in the fat contained in it, a fact of great significance, as we shall see hereafter. Brown-Séquard** by producing a circulation of arterial blood in the body of an animal which had assumed cadaveric rigidity, showed that muscular relaxation and contractility was restored and preserved for a long time, the blood issuing as venous; and he further proved that the elongated condition of muscles required the presence of oxidised blood. I have made experiments along with Mr. Turner, the Demonstrator of Anatomy in the University of Edinburgh, to ascertain whether oxygenated water (peroxide of hydrogen), or a solution of permanganate of potash, would cause relaxation in the muscles of rabbits after *rigor mortis* had set in, as Richardson found. In four rabbits these supplies of oxygen had no effect whatever, either in preventing the access of *rigor mortis* or in relaxing it. I believe, therefore, that this relaxation is not due merely to the oxidation of the muscle, but to its nutrition by the arterial blood, which feeds it while it removes the effete matter. It will be obvious from the tenor of my remarks, although I am unwilling to complicate the present question by a theory, that I agree with Draper†† and others, in considering the contraction of a muscle due to a disintegration of its particles, and its relaxation to their restoration, agreeing also with Dr. Radcliffe‡‡ as to the active state of the relaxed muscle and the exhausted state of the contracted, without assenting, however, to his torpedo discharges as the causes of these states.

21. All these facts prove that transformation of the muscle through the agency of oxygen is the condition of muscular action. Most likely intermediate products are formed before the final forms of carbonic acid and urea are reached. If these graduated changes take place in the muscle itself, the same amount of potential energy will be available as would be if the simplest forms of oxidation were reached at a bound. If lactic acid be the intermediate product of oxidation before carbonic acid, its passage into the latter must be very rapid, for that is continually eliminated from a muscle during its action. And if we thus constantly find that carbonic acid, the highest oxidised form of carbon, is manifested in the substance of muscle during its activity, it is certainly to be expected that the less oxidised form of amido-carbonic acid should be simultaneously produced. In those cases of disease where elimination of urea is retarded, it is found abundantly in the muscles. Thus, in cholera, especially in the muscles which have been severely cramped, urea is detected with ease. In this disease there is a small amount of chloride of sodium in the blood, and its solvent action on the urea is thus reduced. In uræmia, also, it can readily be extracted from muscular substance.§§ Although in the muscles of certain kinds of fish, as in the *Plageostomata* (Frierichs and Städeler), urea may be always found, yet Liebig‖‖ searched for it in vain in the muscles of healthy mammals. Yet this is not surprising when we consider how long search was made for urea in the blood without success. Although the blood contains the sum of the urea of all the transformations proceeding throughout the body, yet as Marchand¶¶ has shown, the quantity of it which can exist in the blood at any one time is so small that it may readily escape detection. If this be true in regard to blood, it is *à fortiori* true in respect to flesh from which the blood is rapidly removing waste matter in the process of the reparation of the exhausted muscle. It may be possible that creatin* is intermediate between tissue and urea, but this is a pure speculation; for although we are acquainted with processes by which it can be split into sarkosin and urea, we know of no simple oxidation which will effect this change. Let us inquire how much urea we may expect to find in flesh in a given time, and it will not appear wonderful that it has escaped detection, even in the skilled hands of Liebig. In an adult man, 520 grains of urea are secreted in twenty-four hours; hence in one hour $\frac{520}{24}=22$ grains. Now, although we know that blood is incessantly and promptly removing waste material from the muscles, let us suppose that a quarter of an hour elapses without any of it being taken up, and that the man is killed at this period. Distributed through all the muscles of his body, there would be about 5 grains of urea; and in 10 lbs. weight of fresh flesh, the quantity operated upon by Liebig, there could not be more than 0·4 grains of urea, or 0·026 gramme. In this estimation we take the weight of fresh flesh at 1800 ounces. In our present state of analysis for urea this small quantity could not be detected.

22. In considering the origin of energy in the muscles, one of three sources is alone conceivable—(1.) The energy might arise in the circulating fluid itself; or, (2.) The oxygen of the blood might consume the fat deposited in the muscle; or (3.) The substance of the muscle must be transformed to provide the energy.†

We have already (§ 20) shown that the changes which take place in muscle during contraction occur in its substance, and not in the circulating fluid of the capillaries, for irritability continues for a considerable time after the blood has been cut off; and we might here recall the well-known fact, that in spite of a larger quantity of oxygen being taken into the lungs than of carbonic acid evolved, and consequently a necessary evolution of latent heat, the blood of the left side of the heart is 0·2 degrees cooler than that of the right side, showing that oxidation of material is not largely effected during aëration of the blood. We may therefore proceed to the second possible source of energy—the combustion of the fat in the substance of muscle.

23. The usual function of fat is unquestionably, like that of starch or of sugar, to keep up the heat of the animal. When they have served this purpose their physiological work is completed, and the *opus calorificum* cannot be changed into *opus mechanicum*, for that must be due to converted heat, or to force, which has never assumed that form. We know that all the fat and starch in food is required to account for the animal heat, because it has always been a difficulty to reconcile the experimental heat actually generated by an animal with the amount available in the food-fuel supplied to it. In fact, until the researches of Andrews, and of Favre and Silberman, gave to us higher calorific values for hydrogen and carbon than formerly, there was no possibility of accounting for the heat actually given out by animals in the experiments of Dulong.‡

** Gazette Medicale, 1851, and Croonian Lecture, R.S., 1861; compare also Stannius, *Vierordt's Archiv.* 1852.

†† Human Physiology, p. 446.

‡‡ Lectures on Epilepsy, 129.

§§ Bühl und Voit, *Zeitsch. fur rat. Med.*, vi. 94; and Von Bibra, *Ann. der Ch. und Phar.*, xciv., 206-215.

‖‖ "Chemistry of Food," p. 142.

¶¶ *Pogg. Ann.*, xxxi., 303.

* Schottin *Archiv. fur Heilkunde*, 1860 417.

† We do not consider it necessary in the present state of science to present a fourth alternative of the origin of the energy from "nervous force." Some old experiments of Matteucci are still, however, constantly quoted in support of this view. He says ("Phys. Phen. of Living Beings," p. 325) that the chemical action of three milligrammes of zinc, oxidating and converted into nervous force, in a frog, produced a muscular power equal to 5·419 metre kilos. But the current emanating from the zinc could only have exercised a directive action on the muscle which it affected. The total energy derivable from the zinc can be found as follows:—

$$\left(\frac{003 \times 1301}{1000}\right)\times 420 = 1\cdot 64 \text{ metre kilos.}$$

Deducting this from 5·42 actually got in the experiment, 3·78 metre kilos. of work must have been obtained from some other source of energy beyond the zinc. There is no other source than the substance of the muscle itself. So long as a muscle is alive and in contact with oxygen it can contract under electrical excitement, and the difference between the work which could be done by the exciting force and the useful work obtained, must be the measure of the energy rendered available by the structural and molecular change of the muscle itself. In a later memoir (*Phil. Trans.*, 1857), Matteucci compares the exciting current to the spark which ignites gunpowder, and would seem to have abandoned his former ideas.

‡ Berl. Med. Ency. art., "Thierische Warme;" compare also Fick, Med. Physik. S. 175, *et seq.*

And even with these increased co-efficients, we require the combustion of all the non-nitrogenous constituents of food to enable us to account for animal heat. But although this is the case, we must bear in mind that only a small quantity of converted heat is theoretically necessary for mechanical work. The energy available in 22 oz. of a starch equivalent of fuel, consumed by a healthy man, would correspond to 2187 kil. units of heat; while the transformation of the muscles of that man, required for mechanical force, yields about 543 kil. units. Although nearly one-half of the latter is spent in internal dynamical work, and passes into heat within the body, still we cannot afford to subtract any of the available work from the heat-givers. Taking it in round numbers, we have 2500 kil. units of heat available from them and converted vital work, and 2700 kil. units are required, according to the estimate of Helmholtz, to account for evaporation, heating of the ingesta, and radiation. The diversion, therefore, of the ordinary ingredients of food, whose proper function is *opus calorificum*, to the production of *opus mechanicum*, is not probable from *à priori* considerations. But it is nevertheless a fact that fat is always present in healthy muscle, and it is desirable to consider its relation to muscular action.

24. The experiments made by Bidder and Schmidt[§] on starving cats, and by Bischof and Voit on a starving dog,[‖] throw light on this subject. From these we learn that during the whole course of starvation fat disappears from the muscle in a regular manner, while there is no such regularity as to the waste of the tissues. The amount of urea falls to one-half in two days; then remains constant for a week, falling again rapidly and considerably two days previous to death; during all this time the daily waste of fat remains nearly constant. Nor is there anything surprising in this difference. As the animal becomes weaker, the internal dynamical or vital motions decrease, and their representative in the urine naturally falls. But the fat continues to burn in the living lamp as steadily as the lungs afford to it oxygen.

When Bischof and Voit supplied their starving dog with fat, the waste of the body, as evidenced by the lessened amount of urea secreted, was diminished, because the fat supported the respiration, which before had partially to depend on wasting tissues. The fat cast over them a protective influence, and limited their waste to the support of their own dynamic functions. And in this fact would seem to be the use of fat after it is stored up in the muscle. We allude to its chemical use; for its mechanical advantage in lessening friction, and its possible histogenetic employment in the formation of cells, are not under consideration. Fat does not form a portion of an organ, for ether can extract it without any lesion of the organic structure. In wild animals the muscular fat is present in only small proportion —not exceeding 2 per cent. of the muscle. In the muscle of an active man the fat amounts to 2·2 per cent. A man in ordinary health and activity wastes daily 1750 grains of dry flesh, or 7000 grains of fresh muscle, which would contain 150 grains of fat. The total amount of heat which this quantity could yield by its combustion is 87 kil. units, while the flesh in which it resides would give by its transformation about 506 kil. units. We need not, therefore, look for the source of potential energy in a minor when we have a major source quite sufficient to account for it. The human heart weighs, on an average, 9·4 oz., and contains, according to Böttcher, a mean of 1·7 per cent. of fat. On the extravagant supposition, in § 18, that it destroys more than half its substance daily in movements, it would use 147·7 grammes, containing 2·5 grammes of fat. This quantity could, by its combustion, give 23·9 kil. units of heat, or 10,157 metre kil. of mechanical force. But we have shown that the useful work of the heart is 37,780 metre kils. So that the fat cannot account for the work performed. In these calculations we refer to fat distributed in and inherent to healthy muscle, and not to masses of fat in adipose tissue, such as we find in fattened animals or obese men, for no one pretends that such separate fat can be the cause of movement in any other sense than that starch, sugar, or other body extraneous to the muscle, may, by some unknown or inconceivable method, have this force transformed from *opus calorificum* to *opus mechanicum*. The chemical use of fat deposited within the muscle may be to protect it from the assaults of oxygen during its repose. A muscle, even at rest, gives out carbonic acid, which is no doubt partly due to the oxidation of its effete particles, but also to the oxidation of fat. The conception that the latter is the source of muscular action can only have arisen from the false analogy of the animal body to a steam-engine. But incessant transformation of the acting parts of the animal machine forms the condition for its action, while in the case of the steam-engine, it is transformation of fuel external to the machine which causes it to move.

25. From the considerations which have preceded, we consider Liebig amply justified in viewing the non-nitrogenous portions of food as mere heat-givers. They never can act vicariously for albuminous bodies as tissue-formers, although tissues may and do evolve heat by transformation when required to do so. That heat-givers do operate indirectly on the waste of tissues cannot be questioned. They facilitate transformation by keeping up animal heat and by the promotion of circulation. Cold-blooded reptiles become more active when artificial warmth is supplied to them, and conversely, warm-blooded mammals become more sluggish when the heat of their bodies falls, as during hibernation. Such dependencies of different groups of food, acting co-ordinately, are incessantly found, but nevertheless each group has its own specific work to perform.

26. While we have been led to the conclusion that the transformation of the tissues is the source of dynamical power in the animal, we have yet to examine whether the appearance of heat, and electro-motive force current in the muscles, may not be produced so as to absorb the force on which we have relied. The muscle during contraction is certainly hotter than at rest, about 0·5° C. warmer, according to Becquerel and Brechet. In fever, the temperature of the muscles rises sometimes to 40° or 41° C., and in tetanus to 44° C. (Ludwig); while Fick has shown that in these cases the muscles are hotter than the circulating blood. But the experiments have been made when the waste of tissue is not producing useful work, and must therefore necessarily pass into heat. Beclard[¶] found, in fact, that the heat developed in a muscle is in inverse ratio to the mechanical effects produced; for example, in trying to raise insuperable weights, more heat is evolved than in lifting lighter weights.[**] Hirn also ascertained, by direct experiment on a treadmill, that less heat is evolved for each gramme of oxygen taken into the body when hard work is done outside the body. In fact, the heat developed in muscles, when not due to the combustion of fat, is probably only the result of lost work, just as we find that the electromotive force disappears almost entirely during the active work of a muscle or nerve[††] (Du Bois Raymond). Even with the wonderful economy of force which the animal as a machine exhibits, we cannot be surprised that some of the lost work is manifested in the forms of heat and electricity. We know, for instance, that all the potential energy rendered available for internal dynamical work must assume ultimately these forms.

(To be continued.)

Chemical Society.—The next meeting of this Society will take place on Thursday evening next, at eight o'clock, when the President, Dr. W. A. Miller, F.R.S., will read a paper "On some Points in the Analysis of Potable Waters."

[§] Das Stoffwechsel, 1852.

[‖] *Die Gesetze der Ernährung*, etc., p. 97, *et seq.*

[¶] *Comptes Rendus*, 1860, i. 471.

[**] *Théorie Mécanique de la Chaleur*, i. 34.

[††] *Untersuchungen über Thierische Electricität*, bd. ii., 511.

CHEMICAL SOCIETY.

Thursday, May 18.

Prof. W. A. Miller, *M.D., F.R.S., President, in the Chair.*

The minutes of proceedings of the last meeting were read and confirmed, and Messrs. Robert Barton and Thomas N. Kirkham formally admitted Fellows of the Society. Certificates in favour of Mr. George Bacon Sweeting, Surgeon, of King's Lynn, Norfolk, and Mr. W. A. Tilden, of the Pharmaceutical Society's Laboratory, Bloomsbury Square, were read for the first and second times respectively. The ballot was taken for the election of Mr. Thomas Fairley, Medical School, Leeds; Mr. Edward Swann, Director of the Laboratory of the London and North-Western Railway Company's Works, Crewe; and Mr. Alfred Upward, Superintendent of the Chartered Gas Company's Works, 148, Goswell Street, London. These gentlemen were severally elected Fellows of the Society.

Dr. J. H. Gladstone delivered a discourse "*On the Specific Refractive Energies of the Elements and their Compounds,*" in which he described the further results of the conjoint labours of himself and the Rev. T. P. Dale, M.A., in a branch of physical research which had been already sketched out in a paper read before the Royal Society, in March, 1863. Since the date of this communication, the subject had been taken in hand by Landolt, who adopted a mode of working very similar to that of the authors. The "specific refractive energy" of a body is a constant, not affected by temperature, and is arrived at by dividing the refractive index of the substance (μ) minus 1, by the density. The formula already proposed was found to hold good on a more extended investigation of the subject, and the authors generally worked with the fixed line A. The proposition resolved itself into a study of the inquiry whether the specific refractive energy of an element was invariable under all circumstances of isolation or combination, and whether this property in the case of a compound was correctly expressed by taking the mean of the refractive energies of its several elementary constituents. As a general rule this was found to be the case, but the authors brought forward a few exceptional instances which at present appeared to stand in opposition to their statement. Dr. Gladstone particularly referred to sulphurous acid, hydrated sulphuric acid, and aqueous tartaric acid, as presenting anomalies which were considered worthy of more extended investigation, with the view of determining the nature of the disturbing causes. This mode of physical research was interesting in connexion with the study of isomerism, and would probably lend valuable aid in determining the internal constitution of bodies; thus, whilst aniline and its isomer, picoline, gave widely different results under this optical treatment, it had been found by Landolt that a mixture of equal equivalents of methylic alcohol and acetic acid behaved precisely like its theoretical conjugate, glycerin! Dr. Gladstone exhibited in a tabulated form the numbers representing the specific refractive energies of many of the elements, multiplied by their atomic weights, or "refraction equivalents," as Landolt terms it, and he worked several examples by way of showing the application of the formula, and the mode of deducing from compound bodies the value of each constituent. The table stood thus:—

Name of element.	Refraction equivalent.
Carbon	5·1
Hydrogen	1·5
Oxygen	3·0
Nitrogen	3·3
Chlorine	8·5
Bromine	15·7
Iodine	24·4
Sulphur	16·0
Phosphorus	18·6
Tin	22·0
Sodium	6·0
Mercury	11·0

With regard to the value of carbon it was shown that the number observed in the case of the diamond agreed with the results deduced from the examination of carbonic oxide, carbonic acid, olefiant gas, and a variety of liquid hydrocarbons. Hydrogen did not appear to have precisely the same value in the form of gas that it had in certain hydrogen compounds, and the author stated that 7·6 was the average expression, from a great number of experiments, of the value of CH_2, the oft-quoted increment of carbon and hydrogen in the homologous series. Nitrogen in the form of gas was 3·3 as above, but in combination its value sometimes amounted to 4·2. In a similar manner the numbers representing oxygen and chlorine gases became subject to modification when those elements were combined.

The President said he had listened with much pleasure to the author's interesting communication, and he wished now to inquire of Dr. Gladstone whether there appeared to be any relation between the remarkable exceptions noticed by him and their observed atomic volume. It was known that oxygen in combination occupied two different atomic volumes, and he thought it possible that there might be some connexion between the volume and refractive energy in this and other similar instances.

The Rev. Thomas Pelham Dale gave an account of the mode by which these conclusions had been arrived at, stating that Dr. Gladstone usually undertook the experimental, and himself the mathematical, department of the inquiry. The formula adhered to in calculating the refractive values was—

$$1\frac{\mu - 1}{d} - = c,$$

and the speaker insisted upon the importance of selecting bodies of high refractive indices—such as bisulphide of carbon—for the purpose of testing the accuracy of the proposed theory. The liquid named was readily procured and purified, and its refractive index for the red rays was 1·6, and for the violet 1·7. Errors might arise from inaccuracies of adjustment, or from an elevation of temperature in the liquid contents of the prism by the passage of the solar beam; but Dr. Gladstone had employed a liquid septum—such as alum solution—in order to cut off the heat rays, and it was not possible that the figure of the hollow prism underwent any sensible alteration during the experiments, inasmuch as frequent observations made with the same liquid gave closely concordant results. He would, however, recommend the use of a prism of 60 degrees, or an equilateral triangle, and make three independent observations, changing the angle each time, and then take the mean of the three results.

Dr. Frankland had hoped that the optical results would have suggested an explanation of the difference observed in the chemical properties of carbon in the form of carbonic oxide, and the more active state of that element existing in combination with hydrogen in olefiant or marsh gas. It appeared that the specific refractive energy remained constant throughout, and that optically there was no distinction between one and the other form of carbon.

Dr. Gladstone replied that his experiments did not indicate the well-marked chemical difference to which Dr. Frankland had alluded. The speaker offered some further remarks with reference to the details of the optical arrangement, and stated that M. Landolt and Professor Stokes had seen no theoretical difficulty in accepting the proposed formula.

The President then moved a vote of thanks to Dr. Gladstone and Mr. Dale for their interesting communication, which was warmly responded to, and adjourned the meeting until June 1, on which occasion he would have the honour of addressing the Society upon the subject of "*The Analysis of Potable Waters.*"

ACADEMY OF SCIENCES.

May 15, 1865.

A memoir "*On the Action of the Metalloids on Glass, and on the Presence of Alkaline Sulphates in all Commercial Glass,*" by M. Pelouze, was read. Carbon, sulphur, silicium, boron,—all would appear to give a yellow colour to glass. Hydrogen also, when passed over the glass in fusion, seems to cause a yellow colouration. How does this happen? All ordinary glass, says M. Pelouze, contains sulphates, and the colouration is due to their reduction, sulphur in every case being the efficient cause of the colour; for glass perfectly free from sulphates remains uncoloured with the before mentioned metalloids; and the same glass is coloured directly by sulphur, and alkaline or earthy sulphides.

The first part of some "*Chemical Researches on Hydraulic Cements,*" by M. Fremy, was read. This paper is of considerable industrial importance, and we shall return to the experimental part. In the meantime we give the author's conclusions as to the cause of the setting of the cements under water. This results, he says, from two different chemical actions. In the one the aluminates of lime become hydrated, and in the other hydrated lime combines with the silicates. The aluminates and the calcareous silicates the author believes to play different parts in the setting: the former simply become hydrated, the latter combine with hydrate of lime. In a future number we shall give an abstract of the experiments described by the author.

M. de la Rive presented a note "*On the Conduction of Electricity by Metallic Vapours;*" these, the author shows, have the same or nearly the same conducting power as the metals in the solid state. The metals were vapourised by the voltaic arc, and on endeavouring to produce the arc with points made of various alloys the author observed that the alloy was always decomposed. To observe this phenomenon better he employed a plate of coke for a negative electrode, and the alloy for the positive, and then was able to collect the two metals which deposited separately on the coke.

In another note M. de la Rive mentioned that a piece of crown or heavy flint glass through which a discharge from a large Rhumkorff is passed, undergoes a permanent molecular modification in its whole extent, losing almost entirely its rotatory magnetic power, and acquiring the properties of a crystalline body, or glass suddenly cooled.

M. Kuhlmann communicated the fourth part of his "*Researches on the Crystallogenic Force,*" in which he shows that crystals produced at a low temperature have forms different to those produced at the ordinary temperature, and are capable of holding much more water. This latter property is not confined to ordinary salts, but extends to sugar, oxalic acid, and other crystallisable organic matters.

M. Persoz presented a "*Second Memoir on the Molecular State of Bodies,*" from which an extract was read. The memoir is of great theoretical interest, and we shall translate this extract shortly.

A note by M. Dietzenbacher, "*On Some Properties of Nitric Acid,*" gave an account of some of the effects produced by a mixture of mono-hydrated nitric acid and Nordhausen sulphuric acid. Such a mixture in the cold instantly oxidises roll sulphur, sets fire to charcoal, soot, and phosphorus, ordinary or red, converts in a few minutes arsenic into arsenious acid—is, in fact, one of the most energetic of oxidising agents. On boiling such a mixture in a retort, oxygen is abundantly given off. The mixture, however, in the cold has no action on some of the most oxidisable metals.

M. Gernez made another communication "*On Supersaturated Solutions,*" in which he again recommends the supersaturated solution of salt as a test for the most minute portions of the same salt in the air, which will, of course, provoke crystallisation in the solution—a test which, he has said before, is more delicate than the spectrum.

Dr. Phipson sent a note "*On the Existence of Silicium in Two States in Cast Iron, and on the Influence of these on the Production of Steel by Bessemer's Process.*" As combined and graphitic carbon exist in cast iron, so the author finds that silicium also exists in two conditions therein; and he adds that as one or the other of these predominates, so we get good or bad steel—a sample in which the uncombined predominates giving the best. Dr. Phipson promises to give in another note his method of estimating the two kinds of carbon and silicium.

M. V. de Luynes presented a note "*On the Reciprocal Action of Orcine and Ammonia,*" in which he shows that orcine absorbs gaseous ammonia with great avidity, and that when the two bodies are brought together in the presence of ether, a crystallised compound of the two is obtained, which is colourless, but changes instantly to violet on coming in contact with the air, without passing through the different shades, which a solution of orcine in ammonia does.

M. Hardy announced in a note the discovery of a large deposit of *Guano formed by Bats.* It is in a large cavern, in which innumerable multitudes of these animals hide themselves during daylight. The composition of the guano when dry corresponds pretty closely to that of good Peruvian, but as found in the cave it contains 60 per cent. of moisture.

NOTICES OF BOOKS.

The Book of Perfumes. By Eugene Rimmel. London: Chapman and Hall. 1865.

It is not often that a reviewer has such a volume as this under his notice. Elegantly bound and deliciously perfumed,—well written, well printed, and well illustrated,—interesting and instructive to read, pleasant to look at, and agreeable to smell, the book charms at once the intellect and the senses.

It is not, as some might imagine, a collection of recipes. Mr. Rimmel would hardly publish his best, and he is too conscientious to deceive his readers with bad. All our pharmaceutical readers know that the published recipes for perfumes are seldom good for anything, and religiously keep their own secrets if they have any. They cannot therefore, blame the author for doing the same. What Mr. Rimmel does give is an interesting account of the use of perfumes and cosmetics in all countries and in all ages. In this there is necessarily much curious information collected from varied sources,—the sacred books, the ancient satirists, and modern travellers supplying the writer with illustrations of the vanities of mankind in various times and places.

But the scientific and commercial aspects of the matter are not altogether overlooked. The reader will find a chapter on the "physiology of perfumes," and also an excellent account of the commercial uses of flowers and plants, and the materials used in perfumery.

The book is essentially a drawing-room book, and will form an agreeable present for any intelligent lady.

Journal de Pharmacie et de Chimie, April, 1865.

Several papers from the *Comptes Rendus* of the Academy of Sciences appear in this Journal. Most of these we may pass by, but one, by M. Berthelot, which we overlooked at the time, may be referred to here, seeing that all this gentleman writes deserves the serious attention of chemists. It describes *a new sort of isomerism*, or *Kenomerism*, from *κενον*, empty. The word may not be well chosen, but the following describes the application of it. Two distinct compounds may by certain reactions lose different groups of elements, and so be reduced to an identical composition, while they possess different physical and chemical characters, and yet retain something of the structure of the original compounds. Alcohol, for instance, may lose two equivalents of hydrogen and become converted into aldehyd—

$$C_4H_6O_2 - H_2 = C_4H_4O_2.$$

Glycol, on the other hand, may lose two equivalents of water and be changed into glycolic ether—

$$C_4H_6O_4 - H_2O_2 = C_4H_4O_2.$$

Glycolic ether and aldehyde are isomers; their composition is the same, but their physical and chemical properties are very different. Here is a perfect case of kenomerism. The author quotes other cases, to which we may return.

We find here for the first time a note by M. Chatin "*On the Milk of the Dromedary.*" This milk is described as perfectly white, of an agreeable taste, and without odour. The fat globules are much smaller than those of cow's milk; the density of the milk rises to 1042 from its richness in sugar; casein and albumen also are more abundant than in the milk of the cow, amounting to $\frac{40}{1000}$. The milk, therefore, appears to be very nutritious, and from the extremely divided state of the fatty matter, very digestible.

A paper by M. F. Ceresoli, "*On Valerianic Acid and the Valerianates of Quinine and Zinc,*" gives an account of these bodies which may interest our pharmaceutical readers, and which we shall therefore translate.

A note by M. Commaille, "*On Valerianate of Quinine mixed with Atropine,*" relates the detection of the latter body in some of the valerianate. How these two bodies came together we can only conjecture, and such a mixture is hardly likely to be made again, but we shall give the author's method of detecting atropine under such circumstances.

A paper by M. Pons, "*On a Volumetric Method of Estimating the Value of Soaps,*" is Clark's test reversed. The author uses a standard solution of chloride of calcium to determine the richness of soaps in fatty acids, adopting mottled Marseilles or Castile soap, as containing the smallest amount of water and no solid adulterants, for a standard soap. The idea is perhaps a good one, and we shall give M. Pons' process.

An extract from the *Proceedings* of the Pharmaceutical Society of Paris contains some observations by M. Roussin "*On the Solidification of Balsam of Copaiba by Lime and Magnesia.*" The author shows that the presence of water is necessary for the solidification to take place, and that calcined magnesia has a strong affinity for moisture, sometimes taking from the atmosphere as much as 15 or 20 per cent. of its weight.

A few short notices we transfer to our "Miscellaneous" paragraphs.

Journal für Pracktische Chemie. No. 4, 1865.

The first paper is Dr. Laspeyre's "*On a Simple and Accurate Process for Estimating Alkalies.*" The process applies to the analysis of rocks, and however accurate it may be, it appears anything but simple. We have also the continuation of Dr. Heldt's "*Studies on Cements,*" and papers by Rammelsberg, which we have already noticed. Crystallographers may, perhaps, read with interest a paper by Carl Ritter von Hauer "*On Cubical and Hemihedral Alum Crystals.*" A note "*On the Separation of Manganese,*" by Dr. Rube, gives a process which we condense. In the analyses of rocks, after the separation of silica by evaporation of the hydrochloric solution, the part soluble in hydrochloric acid will contain the manganese, iron, alumina, &c. This solution the author concentrates, neutralises with carbonate of soda if much free acid is present, and then heats to boiling in a porcelain dish. While boiling he adds freshly precipitated mercuric oxide suspended in water, and continues the boiling for an hour and a half. In this time the suboxide is oxidised to peroxide of manganese, which goes down with peroxide of iron and alumina, lime and magnesia remaining in solution. The author directs the addition of the mercuric oxide until its colour is distinctly recognisable in the precipitate. The manganese, iron, and alumina in the precipitate have then to be separated from mercury and from each other. We do not see any particular advantages in this process.

Chemisches Central Blatt. Nos. 18 and 19, 1865.

All the papers in No. 18 have received some notice in the Chemical News. No. 19 contains a short notice by Dr. Vohl, "*On a Compound of Chloride of Zinc with Aniline, and its Use in the Preparation of Aniline Dyes,*" which we transfer to our pages in another place. There is also an extended notice of Vogel's "*Volumetric Method of Estimating Silver,*" an outline of which we have already given, but now extract the details. A note "*On the Preparation of Gold Purple*" we transfer to our miscellaneous paragraphs. All the other papers have been noticed.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

1227. F. Wise, Chandos Chambers, Adelphi, "A mode of obtaining decoctions and apparatus for carrying the same into effect." A communication from B. G. Martin, Philadelphia, Penn., U.S.A.—Petition recorded May 2, 1865.

1255. W. Henderson, Glasgow, "Improvements in extracting copper and several other metals from certain ores of these metals."

1257. J. Mayall, Roxbury, Mass., U.S.A., "Improvements in the manufacture or treatment of indiarubber or gutta-percha or compounds thereof, applicable to the production of stereotype plates and other forms."—May 5, 1865.

1279. J. G. Hey, Cleckheaton, Yorkshire, V. Savory, Harlishead-cum-Clifton, Yorkshire, "An improved self-acting apparatus for and means of extinguishing fires."

Notices to Proceed.

15. L. D'Aubréville, Boulevart de Strasbourg, Paris, "Improvements in manufacturing paper."—A communication from J. J. Manecy, Fures, France.—Petition recorded January 3, 1865.

39. T. Pickford, Fenchurch Street, "Improvements in preparing and keeping aërated beverages."—Jan. 5, 1865.

42. J. Lebandy, Paris, "A new system of boiling grain sugar in vacuo."

47. W. C. Thurgar, Norwich, "A new or improved method of keeping the substance of eggs fresh and sweet."—Jan. 6, 1865.

56. B. W. Bentley, Buxton, Derbyshire, and W. H. Bailey, Salford, Lancashire, "Improvements in producing and finishing photographs and photographic transparencies on paper and other suitable substances, and in the machinery employed therein."—Jan. 7, 1865.

72. E. Pettitt, Birmingham, "Improvements in giving permanence to, and in ornamenting glass transparent positive photographs."—Jan. 10, 1865.

110. W. S. Longridge, Alderwasely Iron Works, Derbyshire, and J. Mash, Bowden, Cheshire, "Improvements in furnaces."—Jan. 13, 1865.

320. W. E. Newton, Chancery Lane, "Improvements in the preparation of superphosphate of lime."—A communication from R. B. Potts, Camden, N.J., U.S.A.—Feb. 4, 1865.

836.—W. E. Newton, Chancery Lane, "Improvements in the manufacture of ink." —A communication from J. V. Lavers, Sydney, New South Wales, March 24, 1865.

CORRESPONDENCE.

Continental Science.

Paris, May 19.

The annual meeting of the Society of Friends of Science was held at the Sorbonne on the 4th inst. After an opening address by Marshal Vaillant, and a speech by M. Boudet in support of a scientific relief fund started years ago by Thénard, but not much subscribed to, M. Troost delivered a lecture "*On Magnesium and its Applications.*" After describing the manufacture of the metal, he proceeded of course to show the light of magnesium itself, and then of the zinc and magnesium twist devised by M. Leroux. These two metals burn together freely; the light seems to equal that of magnesium by itself, and is of course much more economical. I think I remember having seen in the Chemical News an estimation of the amount of light produced by the combustion of a magnesium wire; but I may as well quote the figures of M. Troost, who is always accurate. He said that a wire 97 millimetres long and one-third of a millimetre thick, gives the light of 64 candles. The French candle standard differs but little from yours, and indeed for ordinary purposes may be taken as the same. M. Troost showed an unpublished experiment of MM. Deville and Caron, who have discovered that magnesium instantly decomposes the vapour of water. If a current of steam is passed into a tube containing fragments of the metal the hydrogen may be burnt at the opposite extremity.

Speaking of M. H. Deville, I may mention here an experiment which that gentleman showed at the last meeting of the Academy. He ignited a stick of charcoal by dipping it into a mixture of monohydrated nitric acid and fuming sulphuric acid. The ignition took place instantaneously.

I read in *Cosmos* that a gold mine of extraordinary richness has been discovered near Grisslehamn, in Sweden. The annual produce is estimated at 20,000 kilogrammes, the value of which at the Bank of England price I must leave your readers to calculate for themselves.

The exhibition of the French Photographic Society is open; but there appears to be nothing worthy of special notice. Photography would seem susceptible of no further development.

The nomadic tribes who inhabit the Steppes of Russia are said to be completely exempt from pulmonary consumption. Another special peculiarity in these people is that they indulge in *Kumis*—an intoxicating liquid made by fermenting mare's milk. Here are two facts for a medical logician, and the inference to be drawn from them is clear. Kumis is prophylactic against consumption—so, at all events, says Dr. Schnepp. But mare's milk is not easy to get here, and the Doctor is obliged to content himself with the nearest approach to that fluid he can find—namely, asses' milk,—from which he prepares an intoxicating drink called *galazyme*, with which he says he treats most successfully all catarrhal affections and consumptions in general.

MISCELLANEOUS.

Royal Society.—The following are the candidates selected by the Council for admission this year:—Henry Christy, Esq.; the Hon. James Cockle, M.A.; Rev. William Rutter Dawes; Archibald Geikie, Esq.; George Gore, Esq.; Robert Grant, Esq., M.A.; George Harley, M.D.; William Huggins, Esq.; Sir F. Leopold McClintock, Capt. R.N.; Robert McDonnell, M.D.; William Kitchen Parker, Esq.; Alfred Tennyson, Esq., D.C.L.; George Henry Kendrick Thwaites, Esq.; Lieut.-Col. James Thomas Walker, R.E.; George Robert Gray, Esq. [We do not observe the name of one chemist on the list.]

Royal Institution.—The following are the arrangements for the ensuing week:—Tuesday, May 30, at 4 o'clock, Professor Frankland, F.R.S., "On Organic Chemistry." Thursday, June 1, at 4 o'clock, Professor Frankland, F.R.S., "On Organic Chemistry." Friday, June 2, at 8 o'clock, Professor Huxley, F.R.S., "On the Methods and Results of Ethnology." Saturday, June 3, at 4 o'clock, Alexander Herschel, Esq., "On Meteorology."

Metalliferous Mines Bill.—Lord Kinnaird has withdrawn the Metalliferous Mines Bill, and for the present no legislation on the subject can be expected. We hope, however, that the noble Lord will persevere in his attempts to secure for the metal miner equal protection with the coal miner.

Working of the Alkali Act.—The first Report of Dr. A. Smith, the Chief Inspector under the Alkali Act, has just been presented to Parliament, and was on Tuesday last the subject of a speech by Lord Derby. The noble Lord congratulated himself on the perfect success of the measure of which he was the author, and paid a merited compliment to Dr. Smith, whose conciliatory proceedings secured the hearty co-operation of the manufacturers. We shall notice the report at length shortly, and now shall only state that every one of the sixty-four works reported upon condense more hydrochloric acid than the Act compels; thirty-three works allow none, or not more than 0·1 per cent. to escape.

Telegraphic Cables.—Any fact that contributes to the stock of our experience relative to the adaptibility of certain materials for the construction of telegraph cables for submarine and subterranean purposes should be deemed valuable, and ought not to be devoid of general interest. A portion of one of the cables made by Messrs. Wells and Hall for the Ordnance Select Committee, laid down at Shoeburyness, has been uncovered during the past few days, and a length cut out to ascertain its condition. After having been buried in the marshes for nearly four years, these wires are found to be electrically perfect. The india-rubber is in high preservation, showing not the slightest sign of decay, but retaining the hard, clear, semi-transparent appearance of Para rubber in its natural state. One well-ascertained fact is worth any number of theories; and having been favoured with a sample of the cable, we are speaking from ocular proof. It is most satisfactory, too, as indicating at least the possibility of making india-rubber wires proof against inherent deterioration. The felt, by which the exterior of the rubber is covered, is also intact; this is doubtless owing to its being a substance, to a certain extent, composed of india-rubber, that material, when in a state of solution, forming a sort of ground upon which the cotton fibre is spread. A serving of tarred yarn, to afford strength and protection to the core, forms the outer part of the cables; but it appears this only lasts for a time. The hemp has completely rotted off, and these wires have had no other protection but the rubber probably for the latter half of the period they have been down, and the perfect state of the rubber would seem to indicate that they did not require any other protection. At any rate, this effectually explodes the notion that tar is a preservative of hemp, when laid underground or in water. It probably might be made more durable if saturated with a compound consisting mainly of the material which forms the core.

ANSWERS TO CORRESPONDENTS.

Atom.—The first volume of Miller's Chemistry.

B.—Yes, the vapour of bisulphide of carbon is very poisonous.

J. T.—The Patent Office has not published a general collection of chemical patents similar to the collections named. Such a publication is very desirable, and, if well classified, would be extremely useful.

T. H.—A glass-blower will make you the apparatus. Apply to Mr. Cetti.

In reply to several correspondents, we may state that no more of the Exhibition Reports are at present procurable. We hope to receive a further supply.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Contributions to the History of the Metals in Cerite and Gadolinite, by M. MARC DELAFONTAINE.*

(Continued from page 242.)

III. Note on the Spectra of Absorption of Didymium, Erbium, and Terbium.—The spectrum of absorption of didymium, first described by M. Gladstone, is well known to all chemists; this is not the case with those of erbium and terbium. M. Bahr, who discovered them, has made them known to the Academie des Sciences of Stockholm.

I thought it would be more convenient to unite the detailed descriptions of these three spectra, a knowledge of them being so essential to distinguishing erbia, terbia, and oxide of didymium.

A very diluted solution of nitrate of didymium examined through the thickness of 7 or 8 centimetres, showed three rather indistinct black rays, indicated in Fig. 3 by *a, b, c.* The fact of this spectrum being confounded with that of terbium, may again render doubtful the existence of the latter metal, but terbic nitrate, even when fused to the state of limpid glass, shows no new ray; the others are only enlarged, and much blacker. It is not so with didymium; when part of the water has been expelled by evaporation, the three rays above mentioned change very dark bands; at the same time four others arise, denoted by the letters *d, e, f, g.* The whole constitutes the usual spectrum of didymium; however, with very concentrated liquids there are besides the lines *h i*, and one or two others difficult to distinguish in the violet. Erbium generally gives five rays and bands, and eight when it is in the form of a syrupy solution. Er persists even after the disappearance of all the others. (Fig. 1.)

As I have said, terbium is characterised by three bands, only two of which are very clear, the third, Tr_c is indistinct and possibly does not belong to it at all. (Fig 2.)

By determining the positions by means of a graduated scale such as Na = 27, Liα = 10, and Tl 43, I found that:

Di h =	9	Tr a =	30—32	Er f =	9
i	19	b	48—50	d	14
a	28—32	c	85—89	g	16
b	48—50			h	42
d	54—55			e	44
e	66—67			a	48—50
g	70			b	65
f	73—75			o	85—90
c	85—91				

Beyond which the positions are uncertain, except perhaps, K = 107—110.

As will be seen, two bands are common to the three elements (Di_b Tr_b Er_a and Di_c Tr_c Er_c) and Er_f is compounded with Di_h.

Note on the Carbides of Yttro-Ceric Metals, by M. DELAFONTAINE.

BY decomposing formiate or oxalate of cerium by heat in a fall and covered crucible, or better, in a tube traversed by a current of pure dry hydrogen, a greyish-black powder is produced, which will ignite and burn on contact with the air, like German tinder, if thrown while still hot on a sheet of paper or any other bad conductor of heat. This powder remains unaltered after cooling,

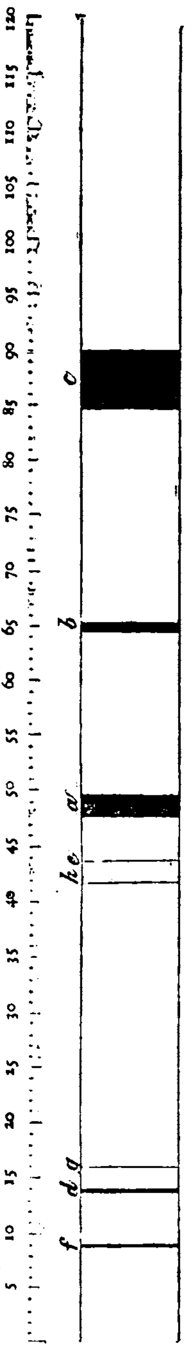

FIG. 1 Erbium

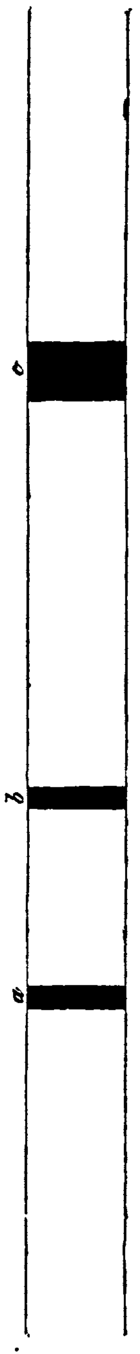

FIG. 2. Terbium

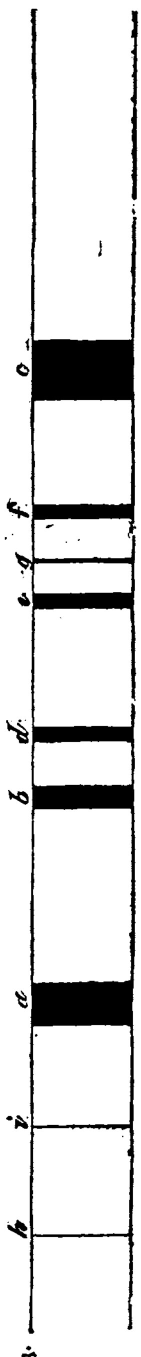

FIG. 3. Didymium

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* Bibliothèque Universelle et Revue Suisse, xxii., 30, 65.

and may then be preserved in an uncovered vessel. Digested with diluted hydrochloric acid, it slowly disengages small odourless bubbles. After two or three days the liquid contains a certain quantity of cerous chloride, while there remains an abundant dense black residue, with difficulty attacked by mineral acids even when hot and concentrated. This product is a carbide of definite proportions, which may be represented by the formula CeC_2, in spite of an excess of carbon, which in two preparations may vary from two to four centimes.

Carbide of cerium is not a new body. Göbel formerly obtained it by means of formiate; Mosander, and quite recently M. Popp, by means of oxalate. Mosander even made an exact analysis of it. Göbel and M. Popp described it as metallic cerium.

The formiates of lanthanum and didymium, oxalates of the same bases, and those of yttria, erbia, and terbia form, in decomposing, carbides bearing great analogy to those of cerium. Acids, however, seem to attack them more readily. I have frequently had occasion to observe their production in the course of my researches when I have calcined several grammes at a time of oxalate of yttria, erbia, and terbia in a small deep platinum crucible. Their presence is inconvenient in an earth which is to be redissolved.

In decomposing, formiates have a movement similar to that of a boiling liquid, and they escape by the smallest interstices, burning like fusees.[*] This renders the use of oxalates much preferable in the preparation of carbides.

I intend to devote a special work to the various circumstances attending the curious method for decomposing formiates and oxalates to which I have drawn attention. My experiments are not sufficiently advanced to admit of my representing them by an equation.

The Existence of Bichloride of Manganese and its Congeners of Bromine and Iodine, by M. J. NICKLES.[†]

ON treating peroxide of manganese with hydrochloric acid free chlorine is obtained according to the equation:

$$MnO_2 + 2ClH = 2HO + MnCl + Cl.$$

In giving this equation it is usually added that only half the chlorine is disengaged, because the compound corresponding to peroxide of manganese—that is to say, the perchloride $MnCl_2$ does not exist, for if it did exist, the equation would be—

$$MnO_2 + 2ClH = 2HO + MnCl_2.$$

and consequently no free chlorine.

The object of this paper is to show that this perchloride may really be obtained, as also its congeners bromide and iodide, if not fluoride.

Having ascertained that, if water readily destroys certain perchlorides, perbromides, &c., ether, on the contrary, renders them more stable, I saw in this fact the possibility of filling, in the group of chlorides, a hiatus which theory has hardly tried to fill.

This may be effected in two ways, either by treating with a current of dry chlorine, the protochloride of manganese placed in ether, in alcohol, or any other anhydrous liquid capable of dissolving the compound to be obtained, or by acting on the peroxide of manganese with dry hydrochloric gas, in the presence of one of these liquids.

The latter process is the most simple and gives the best results. By merely shaking in a tube a little powdered peroxide of manganese with anhydrous ether, saturated with hydrochloric acid gas, a liquid of a beautiful green colour, containing the compound in question, is immediately obtained.

This is a lecture experiment. It is always successful, especially when the vessel is previously cooled, for which purpose cold water will suffice, but ice is preferable. But to obtain a quantity of this perchloride, dry hydrochloric gas should be passed into a properly cooled mixture of peroxide and ether.

The product, of a green colour, alters very easily, and evolves hydrochloric acid gas. Soluble in any proportion in ether, it is insoluble in sulphide of carbon. Phosphorus decolorises it, forming protochloride of manganeses, so also do iron and zinc filings, powdered antimony and sulphide of antimony; the last causes besides, a disengagement of sulphuretted hydrogen; sulphide of lead gives free sulphur, alkaline iodides give up iodine, and organic colouring matters, such as indigo, are rapidly destroyed. Water decomposes it, but its action is more prompt in the presence of hydrochloric acid.

The composition of the green solution agrees with the formula—

$$MnCl_2 + 12(C_4H_6O) + 2HO.$$

Though this compound is soluble in anhydrous ether, two distinct layers are not formed, as with halo-metallic ethers (*Comptes Rendus*, lv., 537); I do not, however, consider it as less well defined. In fact, this cannot be a simple solution in ether; for by treating peroxide of manganese by water saturated with hydrochloric acid, a brown liquid is obtained, becoming green in the presence of anhydrous ether, and thus forming a product similar to the preceding.

Perbromide of manganese is obtained in the same way as the perchloride, it is less stable, however, and is easily reduced into sesquibromide Mn_2Br_3.

Some remarkable analogies are connected with peroxide of manganese. The colour of all these compounds is more or less green.

This is also the colour of the compounds given by the sesquioxide Mn_2O_3 with hydrochloric, hydrobromic, and hydriodic gases, ether, and anhydrous alcohol. The ethereal combinations seemed to me more stable than those obtained with alcohols. The oxide employed is the compound Mn_3O_4 obtained by calcining carbonate of manganese free from iron.

These facts show the existence of a great many haloid compounds, which have not hitherto been obtained; and of this number the combinations corresponding to the oxides Ni_2O_3 and Co_2O_3. I am also certain that it is possible to prepare sesqui-iodide of iron Fe_2I_3, the existence of which was left in doubt. (Gmelin, *Traité* iii., 235.) This iodide, it is true, is very unstable. Finally, I have succeeded in carrying out an idea of H. Rose's (*Poggendorf Annalen*, cv., 572, 58,) by preparing chloro-arsenic acid $AsCl_5$, by means of ether and dry hydrochloric gas, for which all other modes of preparation have hitherto failed.[‡]

Few of the higher oxides resist chloridation or bromidation by the means above described. As these oxides are then transformed into the corresponding chloride or bromide, it will be seen that this is a general process, which, properly employed, will lead to this fact—that each degree of oxidation of a metal has its representative in the group of chlorides. I hope to prove this by experiment.

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[*] Chemical treatises generally cite formiate of lead as the least soluble of all; however, formiate of cerium, and especially those of lanthanum and didymium, go far beyond it in this respect.

[†] *Comptes Rendus*, lx., 479, 65.

[‡] This new acid is in the form of an ethereal combination, is unstable, and easily reduced into chloro arsenious acid. Less dense than the latter, and not miscible with it, chloro-arsenic ether separates spontaneously, and may be collected by simple decantation. With water it instantaneously gives arsenic acid.

Presence of the Benzol Series in Canadian Petroleum, by C. SCHOLEMMER, *Esq.*[*]

PELOUZE AND CAHOURS state that American petroleum which they used did not contain hydrocarbons of the benzol series, whilst I found a not inconsiderable quantity of these compounds in the rectified petroleum from which I isolated the hydrides of heptyl, &c. As it was not impossible that this was an accidental or intentional admixture, I endeavoured to procure some genuine crude American petroleum, but I did not succeed in obtaining crude genuine Pennsylvanian, as none of it had reached the Liverpool markets for months. I, however, got some real Canadian rock oil as a thick black liquid of a very unpleasant odour. I distilled it, and treated the portion boiling below 150° C. with concentrated nitric acid, which acted violently. The acid liquid was then diluted with water, and heavy liquid nitro-compounds separated, possessing the odour of bitter almonds. These were treated with tin and hydrochloric acid, and the solution thus obtained was distilled with caustic potash. The aqueous distillate, in which some drops of an oily liquid were suspended, had the odour of aniline, and gave, with a solution of bleaching powder, the most distinct aniline reaction. The beautiful rosaniline reaction could also easily be obtained by heating one of the oily drops with bichloride of mercury. Canadian petroleum contains, therefore, the series of benzol hydrocarbons. In the preparation of hydride of decatyl from rectified petroleum, the portion boiling between 150° and 170° was purified by nitric and sulphuric acids, and thus liquid and nitro-solid compounds obtained. The solid portion was several times recrystallised from alcohol, and the whole of the needle-shaped crystals thus obtained gave on analysis numbers very nearly agreeing with the formula of trinitro cumol, $C_9H_9(NO_2)_3$.

On a Convenient Process for Preparing Oxygen, by M. FLEITMANN.[†]

THE easy preparation of oxygen for technical purposes is a matter of considerable importance, and I now shortly describe a process which possesses particular scientific interest. I was led to the process by observing that on heating a concentrated solution of chloride of lime with only a trace of freshly prepared moist peroxide of cobalt,[‡] the hypochlorite of lime was completely decomposed into chloride of calcium and oxygen. Repeated quantitative experiments, the results of which I have lost, convinced me that the whole of the oxygen was evolved, and that only chloride of calcium and no chloric acid was formed.

The evolution of oxygen commences about 70° or 80°, and continues in a regular stream, with a slight frothing of the liquid.

The action of the peroxide of cobalt in this case, it is clear, is exactly like that of nitric oxide in the manufacture of sulphuric acid. There is no doubt that several peroxides of cobalt with various proportions of oxygen exist. My own experiments have shown me that the proportion of oxygen in peroxide of cobalt is variable, and the simplest explanation of this process is that a lower peroxide abstracts oxygen from the hypochlorite of lime to form a higher oxide, which is again decomposed into a lower oxide and oxygen.

The peroxide made use of in one experiment may be employed again to decompose a fresh quantity of hypochlorite of lime. From one-tenth to one-half per cent. is sufficient to effect the reaction; and instead of taking the freshly prepared hydrated peroxide, it will suffice to add to the solution of hypochlorite a few drops of a solution of cobalt salt, whereby a corresponding amount of the peroxide is formed.

The advantages of this method of procuring oxygen appear to be the following:—

1. The evolution proceeds with extraordinary regularity, and the gas is collected with the greatest ease, which makes the process specially applicable as a lecture experiment. When the mixture has been heated to 70° or 80° the lamp may in general be removed, as the heat of the fluid is then sufficient to carry on the reaction to the end.
2. The *whole* of the oxygen is obtained from the material, while only a part is procured by heating peroxide of manganese, and
3. The process has the advantage of greater cheapness than that with chlorate of potash (either with or without manganese).

It is necessary to employ a clear solution of chloride of lime, as a thick or murky solution will froth over. The best way of making a clear and strong solution is by first extracting one portion of chloride of lime with water, decanting the clear liquor, and then make use of that to exhaust another portion of the chloride. In this way it is easy to get a liquor which will evolve from twenty-five to thirty times its volume of oxygen. On the small scale it is best to employ a capacious flask, which may be about seven eighths filled with the solution. On a large scale for technical purposes a sort of steam boiler might be used, and the oxygen so obtained under pressure, and capable of being employed as a blast.

In a note the author suggests that a very pretty experiment may be made to show the displacement of oxygen by chlorine, by passing the latter gas into a mixture of solution of caustic soda with some peroxide of cobalt. The chlorine could be passed in on one side, and oxygen collected at the other.

The Formation of Cyanogen and the Action of Ammonia on Carbon at a Red Heat,[§] *by M.* WELTZIEN.

ACCORDING to M. Kuhlmann, ammonia acts on carbon giving cyanide of ammonium and marsh gas.

$$\Theta_3 + 4NH_3 = 2(\Theta_2N,NH_4) + \bar{\mathrm{C}}H_4.$$

The author believes that this reaction does not correctly express what happens, because an uneven number of molecules of carbon take part in the reaction, and he supposes that ethylene and acetylene are formed at the same time, while, according to M. Langlois, hydrogen is set at liberty.

M. Weltzien passed dry ammoniacal gas on carbon heated to redness and previously purified by a current of chloride; cyanide of ammonium, hydrogen, and nitrogen were formed, but no carbonated hydrogen. It is to be observed that only 3 atoms out of 26 of nitrogen were used to form cyanide of ammonium.

Nitrogen being triatomic—that is to say, capable of replacing three atoms of hydrogen, the author believed it would be possible to transform methyle into cyanogen by the actiou of anhydrous nitrous acid.

$$\left.\begin{matrix}\bar{\mathrm{C}}H_3\\ \bar{\mathrm{C}}H_3\end{matrix}\right\} + \left.\begin{matrix}N\Theta\\ N\Theta\end{matrix}\right\}\Theta = \left.\begin{matrix}\bar{\mathrm{C}}N\\ \bar{\mathrm{C}}N\end{matrix}\right\} + 3H_2\Theta.$$

For this purpose he passed the vapours of anhydrous

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[*] Note in paper on Hydrocarbons. *Trans. Roy. Soc.*, v., xiv., p. 168.

[†] *Annalen der Chemie und Pharmacie*, April, 1865, p. 64.

[‡] Peroxide of nickel acts in a similar way, but not so energetically.

[§] *Annalen der Chemie und Pharmacie*, cxxii., 224.

nitrous acid and methyle, the latter produced by electrolysis, and consequently mixed with hydrogen ove oxide of chromium heated to redness, but he observed no formation of cyanogen.

TECHNICAL CHEMISTRY.

On the Compounds of Chloride of Zinc with Aniline, and their Use in the Manufacture of Dyes, by Dr. Vohl.*

A neutral aqueous solution of chloride of zinc mixed with aniline solidifies in a short time to a crystalline mass or magma, from which the mother liquor can be easily drained. The crystals may afterwards be dissolved in boiling alcohol, from which solution the compound deposits in the form of brilliant white needles.

The author regards this salt as a *chlorozincate of aniline* ($ZnCl + C_{12}H_7N$). It easily dissolves in dilute hydrochloric acid, forming a new salt—hydrochlorate of chlorozincate of aniline. On the evaporation of the solution this salt crystallises out in large colourless plates, which soon change in the air, and take a violet-blue colour. The salt is very soluble in spirit of wine and in water; strong hydrochloric acid precipitates it from the aqueous solution. It loses its water of crystallisation at 100°.

The first of these two compounds may be prepared directly from nitro-benzol by mixing in a retort 12·3 parts of nitro-benzol, 20 parts of zinc, 75 parts hydrochloric acid (sp. gr. 1·17), and as much alcohol as is necessary for the solution. The retort must be arranged so that the vapours given off on heating may run back into the vessel. After the formation of the aniline the mixture is kept on a water-bath at 100° until all the zinc is dissolved. Then a mixture of 14·5 parts of crystallised carbonate of soda, with 4 parts of dilute spirit (19 per cent.), is added; the whole heated to boiling, and the liquor filtered. On cooling, the chlorozincate of aniline crystallises out, and the crystals may be collected and pressed from the mother liquor. From 12·3 parts aniline the author obtained 15·2 of the compound, instead of 16.

For the direct preparation of the second compound, an excess of hydrochloric acid must be added at the end of the operation just described, the alcohol distilled off, and the residue evaporated to dryness on a water-bath. The compound may be purified by recrystallisation from spirit of wine or water.

To prepare fuchsine, the acid chlorozincate of aniline is mixed with the oxidising agent and heated on an oil or paraffine bath to 180°; convenient proportions are 16 parts of the zinc aniline compound and from 7·2 to 8 parts of mercuric nitrate; or, still better, half mercuric and half mercurous nitrate. The mixture soon becomes dark red—almost black, indeed—and pasty; and on cooling forms a hard mass, which can be easily powdered. The purple and the red can now be separated by the usual means. Arsenic acid, chloride of tin, &c., &c., may, of course, be used as oxidisers in place of the mercuric nitrate.

Aniline blue is obtained by heating 20 parts of the acid zinc compound with 8 parts of mercurous nitrate. The mixture is slowly heated in a paraffine bath up to 200°. When cold, the powdered mass is extracted with boiling water, whereby the blue is separated from traces of fuchsine.

PHYSICAL SCIENCE.

On the Application of Spectrum Analysis to Microscopical Investigations, and especially to the Detection of Blood Stains,† *by* H. C. Sorby, *F.R.S., &c.*

(Continued from page 234.)

It thus appears that in various conditions blood yields no less than eight very different spectra. At all events, we can most readily get four or five, so characteristic, that with proper care there could be no fear of confounding it with any other substance that I have hitherto examined, and probably not with any in existence. However, in all important investigations, it would be advisable to examine the spectra of any substance likely to be present. I would also specially insist on the importance of carefully attending to the exact position and character of the absorption-bands; and before any one gave evidence on such a subject, that he should make himself practically familiar with the facts I have described.

In applying this method to the detection of blood-stains on various articles of clothing, it is requisite to ascertain the effect of the different materials, dyes, and mordants. I have for this purpose made a great many experiments, and yet probably much remains to be learned. As a general rule, the dyes exercise little or no prejudicial influence; but when alum has been used as a mordant, it produces an effect which might easily mislead. Hitherto I have not been able to overcome the effect of the tannin in different sorts of leather. They precipitate the colouring-matter of the blood, and no spectra can be obtained. If, indeed, the blood can be scraped off from the surface without any considerable amount of leather, it can be detected as usual; but if it had been sponged or washed, probably no trace whatever could be detected. The same applies in the case of those woods which, like oak, contain tannic acid. Vegetable soil, when its amount is large in proportion to that of the blood, also precipitates the colouring matter in an insoluble form; but, where the relative amount is small, as on dirty clothes, it does not sensibly interfere with the test, though it tends to impair its delicacy.

When scarlet or brown cruorine is acted on by a solution of alum, it is converted into hæmatin. If it has been used as a mordant, sometimes a portion remains in such a condition as to produce this change in blood-stains; and, moreover, the alumina may combine with the colouring-matter of the blood, and make it insoluble. In such cases it is impossible to obtain the spectrum of either scarlet or brown cruorine; but if a piece of cloth, mordanted in this manner, marked with blood, be digested in a few drops of water in a watch-glass, and repeatedly squeezed with forceps, a turbid solution is obtained, which, treated with citric acid, filtered, rendered alkaline with ammonia, and deoxidised with protosulphate of iron, shows quite well the spectrum of deoxidised hæmatin No. 8.

In a few cases the colouring matter of the dye is slightly dissolved by water.. I have especially noticed this in the case of black printed calico; and if much of such material containing very little blood be digested in water, the dye may cut off the characteristic part of the spectrum. Care should, therefore, be taken not to use any of the material not well marked with blood, and to have the solution so dilute that the dye may not cut off the green rays.

Almost everyone must have noticed the fact, that when a blood-stain on white linen or calico has been ex-

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* *Dingler's Polytech. Journal*, Feb., 1865, p. 211.

† From the *Quarterly Journal of Science.*

posed to pure air for only a short time it can be almost entirely dissolved out by water; but if dried and exposed for some time, the imperfectly soluble brown cruorine cannot be entirely removed, and leaves a brown stain, which, though readily seen on white material, might be scarcely visible on coloured or black. However, on digesting the suspected portion in a few drops of water with citric acid in a watch-glass, and proceeding as already described, a most unmistakeable spectrum like No. 8 may be obtained, even when the stain is only half-an-inch square and scarcely visible. In attempting to remove a blood-stain from cloth by sponging, on the first application of the water a solution of blood would be formed, and run into the surrounding cloth by capillary attraction. Hence, though the stain may appear to have been removed, the cloth round about might, and probably would, retain abundance of the colouring matter, which could be dissolved out. Any suspicious marks that might be due to such treatment should therefore be examined with care. Of course, in such cases the microscope alone would be of no avail, and mere chemical tests could not be relied on, and thus the spectrum method becomes especially useful. Specimens of this character having been placed in the hands of some of the first authorities in such inquiries, they said that neither they nor any one else could make out anything from them; nor would they believe that I could, though the amount of blood was such that in a few minutes I could have shown such a spectrum as No. 8, and have been in a position to give evidence with great confidence.

When soap is present it causes a precipitate; but this is quite soluble in plenty of ammonia, and does not prevent our seeing the spectrum No. 8. Boiling water, instead of facilitating the removal of blood, makes it more fixed by coagulating the albumen. If the blood be dried on glass, the colour is changed to a brownish red, and it gives a spectrum like No. 5, whether dry or damp. When dissolved by citric acid it yields hæmatin, and readily gives spectrum No. 8.

In some cases foreign matters, or the mordants, make the solution so turbid that it is difficult to see the spectrum to advantage. If we wish to observe the spectrum of blood in its natural state, or as it becomes by mere exposure to the atmosphere, it is better not to filter, but to allow the solution to stand in the cell in front of the slit until it has become sufficiently clear, because filtering would probably remove much of the colouring matter of the blood. However, in some varieties of brown cloth the mordants give rise to such a turbid solution that it is very difficult to see the spectrum in a satisfactory manner. Citric acid should therefore be added to make the colouring matter more completely soluble, and the liquid filtered. For such small quantities a blotting paper filter ¾ of an inch in diameter should be used. It can be conveniently supported on a platinum wire bent at one end into a ring, and made to slide up and down a small wire for a support; and if the bottom of the filter touch the cell or watch-glass, though the liquid may pass through slowly, the final result is far more satisfactory. After the acid solution has passed, it is well to add the ammonia by allowing it also to go through the filter, to carry away any colouring matter, soluble in that reagent, that might remain on the filter.

Though in actual practice many other facts may turn up to render special modifications necessary, yet the following is the method I should adopt in examining a mark or stain supposed to be due to blood, assuming that only a small quantity was at my disposal. I should first cut off a portion of the material where not marked, and digest it in four or five drops of water in a watch glass, squeezing it with forceps, and moistening it over and over again. If the solution became coloured, I should introduce it into a cell and determine the character of the spectrum, both in its natural state and after having been acted on by the different reagents already mentioned. I should then add a very little blood to a few drops of water, and digest in that solution a small piece of the material, so as to make out whether it contained anything that acts on the colouring matter of blood. Having satisfied myself on these points, I should cut off a small bit of the stained portion, using from $\frac{1}{10}$th to $\frac{1}{4}$th of an inch square, according to the character of the mark and the amount of material at my disposal, and digest it in three or four drops of water in a watch glass. If the solution became well coloured, I should not squeeze the material so much as to detach many minute particles of foreign matter; but if there appeared to be very little colour present, I should dissolve from it all I could, and take care to waste as little solution as possible, and have no more than would properly fill the cell. Transferring the solution to a cell about ½ inch long and $\frac{1}{8}$th inch in diameter, and having placed it horizontally in front of the slit and left it a short time, so that the minute particles of foreign matter might settle to the lower side of the tube, I should examine the spectrum, and carefully note the exact position and general characters of the absorption bands, if the solution were too strong diluting it until they were well seen. If the spectrum were like No. 2, I should feel nearly sure that the mark was due to blood; and if it had been kept dry in a town I should also conclude that it was nearly fresh. If it were as No. 4 I should feel inclined to believe that it had been exposed to the air for some time; but, unfortunately, the character of the atmosphere makes so much difference that no rule can be given. If, however, in any particular instance a knowledge of the length of time that had elapsed since the blood was fresh were of importance, a more definite opinion might be formed after a few days' experiment with fresh blood, keeping it, if possible, under the same conditions, and using the same material as in the case in question. If the spectrum obtained was like No. 4, I should add ammonia in excess so as to obtain one like No. 5, and afterwards add citric acid in excess so as to see spectrum No. 7. Then adding excess of ammonia and a small quantity of protosulphate of iron, stirring it to dissolve all the oxide, but not so much as to peroxidise and make the solution so yellow that it would not transmit the green, the spectrum No. 8 would be well seen, even when a very small quantity of blood had been present. If plenty of material remained, I should take another portion, dissolve the blood from it, add citrate of ammonia, taking great care that the solution was never acid, and then deoxidise by means of a little protosulphate of iron, so as to obtain No. 6; and I should also mount a dry specimen on glass, to keep as a permanent proof. If all the characteristic results followed, I think no one could hesitate in giving evidence that the mark was blood; though, of course, these facts alone would not decide whether or not it was human. If possible, that must be accomplished by other means, or a conclusion formed from other considerations.

If the quantity dissolved out at first gave a very faint spectrum, it would be well not to attempt to see the spectra Nos. 5, 6, 7, but to act on the solution with citric acid, filtering, if requisite, and then to add ammonia and protosulphate of iron, so as to obtain No. 8. The material itself might also have so acted on the blood that no other spectrum could be seen. It is, however, so characteristic, that, even then, one could scarcely hesitate in deciding that the stain was due to blood.

If the material had evidently been washed, so that no spectrum could be obtained from a simple solution, having first ascertained what effect citric acid has on the dye, I should digest a stained portion in a solution of one-third or one-fourth of a grain of citric acid in a few drops of water, so as not to have more liquid than will fill the cell, filter, if requisite, add excess of ammonia, and then protosulphate of iron. Unless very thoroughly washed out whilst the blood was quite fresh, no mere washing with hot or cold water without brushing or other mechanical means being adopted to dislodge the minute insoluble particles, will so completely remove the stain that it could not be detected in this manner, except, indeed, any of those foreign substances be present which precipitate the colouring matter in a form insoluble in citric acid and ammonia.

Supposing a clear coloured solution be obtained, which gives a different spectrum or set of spectra to those characteristic of blood, it might be desirable to ascertain the nature of the substance to which they were really due. I have already described the spectra of a few colouring matters, but in all cases I strongly recommend the study of the spectra of any substances likely to occur in any particular instance. Even if blood has been detected this would also be desirable, since an opinion could then be given with more confidence.

My conclusion is, that, even in cases where the usual tests would fail, the detection of minute traces of blood need not in general be a weak point in the evidence of crime. Having proved it to be present, the question of its having been human or not must be decided by other considerations; and thus, as a positive proof, the evidence may be equivocal; but if a stain supposed to be due to blood, which, if it were, would certainly give the characteristic spectra, fail to do so, the negative evidence would be decisive.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, April 28.

"*On the Food of Man in relation to his Useful Work.*" By Lyon Playfair, C.B., LL.D., F.R.S.

(*Continued from page 248.*)

Division III.

Secretions as Measures of Work.

A. *Secretion per vesicam.*

27. We have now to examine how far the secretions present us with measures of the work performed by the body. Commencing as we did in the first division of the lecture, it is necessary to inquire how far the urea secreted by a man living on a mere subsistence diet represents the amount of tissue which we have supposed to be wasted in internal dynamical work. Further on it will be seen that, in a man of good digestion, at least one-twelfth of the nitrogen of the food passes away in the fæces, without having been built into muscle or other tissue. Hence, of the 875 grains (2 oz.) of flesh-formers required to support *opus vitale*, 73 grains will pass out *per anum*, and 802 grains will be moulded into tissue, and be transformed into urea and the other products of wasted muscle. Hence, in the urine of a man supported by the lowest diet sufficient for life, we should still find 267 grains of urea. The same amount must appear in the first days of starvation, during which life is supported by the wasting tissues; or what is the same thing, it will appear when non-nitrogenous food is taken. In Ranke's experiments upon himself, we find that, in the first case, he passed 17·02 grammes of urea, and in the second case 17·10 grammes.[*] The mean gives 263 grains of urea—a number remarkably close to our calculated quantity, and probably identical, if the undetermined uric acid be accounted for. Beigel[†] during a three weeks' "hungercur" found the urea sink to 17·83 grammes, or 275 grains. A patient in the fifth week of typhus would possibly pass even less than 267 grains of urea, because part of the subsistence food, in the low state of dynamical vital work, would go to build up tissue; and accordingly we are not surprised to find that Brattler,[‡] in the fifth week, found the urea as low as 16 grammes (247 grains). But when the patient becomes convalescent, and receives the standard diet for quietude—viz., 2·5 ounce of flesh-formers, he should then pass 335 grains of urea. Turning to the researches of Vogel[§] and of S. Moos,[‖] we find that the secretion gradually rises from 22 grammes (336 grains) to the normal quantity of 35 grammes. Haughton[¶] also states that convalescents in Hospitals pass about 300 grains of urea.

28. The experiments of the latter observer on the amount of urea secreted by average healthy men, living on a mixed diet, give from 660 to 580 grains. The mean of the extensive table of analyses in Parkes'[**] excellent work is, however, only 512 grains. If we add to this his average for uric acid, in its equivalent of urea, we would have 521 grains. If, now, we take as a mean, for the present, the results of Barral,[††] Valentin,[‡‡] Vierordt,[§§] and E. Smith,[‖‖] for the nitrogen in the fæces as being about one-eighth that in the urine (one-twelfth according to Ranke), then this, calculated as urea, would give $521 + 65 = 586$ grains of an equivalent of urea. We can convert this into flesh-formers:—

$$586 \times 3 = 1758.$$

Now, 4 oz., or 1750 grains, form the usual diet of non-labouring men.

It will thus be seen that numbers closely approximating to the demand are obtained from recognised averages. But in order to apply them to the special class of healthy men (soldiers) described in Table II., we must take the diet as there given. Soldiers during peace are supposed to be well exercised by a daily march of seven miles. This march represents work equal to 38,333 metre kilos. If we take Haughton's mean of 575 grains of urea for such men, then the tissue transformed to produce this would be 3·94 oz., to which, using Ranke's proportion of one-twelfth of nitrogen in fæces, as we do for reasons hereafter to be stated, 0·33 oz. have to be added; making 4·27 oz. as against 4·21 oz. in Table I. Taking, then, 3·94 oz., we have:—

Potential energy in transformed tissue, 211,822 metre kilos.
Useful external work, . . . 38,333 „

But as the former number includes the energy required to support *opus vitale*, we obtain the amount available for external dynamical work by subtracting it:—

$$211,822 - 107,524 = 104,298 \text{ metre kilos.}$$

Hence we have still nearly three times as much force available as is represented by useful work; but we need not be surprised at this when we know that the healthy soldier is capable of more exertion than he takes in peace.

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[*] Müller's Archiv. 1861, S. 358.

[†] Nov. Acta. Acad. Nat. Curios. xxv.

[‡] Ein Beitrag zur Urologie, 1858, p. 19.

[§] *Zeitschr. f. rat. Med.*, iv., p. 362, *et seq.*

[‖] *Idem*, vii., p. 291.

[¶] Urine of Healthy Men, p. 30.

[**] Parkes on Urine, p. 15.

[††] *Comptes Rend.*, xxviii., 361. *Ann. de Ch. et Phys.* [3], xxv., 129, 171.

[‡‡] Text-Book of Phys. 326.

[§§] Vierordt, Phys. 192.

[‖‖] Phil. *Trans.*, v. 151, p 747, *et seq*

29. Passing from our standard man in health to a hard-worked labourer, we can readily calculate how much urea should be produced by his plastic food. We obtain the amount which is transformed from tissue by deducting that which passes away as fœces:—

$$2406 - \frac{2406}{12} = 2205{\cdot}5 \text{ grains.}$$

Without any error worth taking into account, the urea may be obtained by dividing this number by 3 (the correct number is 3·01); hence the working man, doing really a hard day's labour, should have 735 grains of urea in his urine, including its equivalent of uric acid. There are very few estimates of the urine of hard-worked labourers, and I have found it no easy matter to induce them to be made the subject of experiment. Nevertheless, in conjunction with my friend Dr. A. Dalzell, I have estimated the amount of urea in the urine on hard-worked labourers, and we are still continuing our inquiries on this subject. Before alluding to them, it will be more convenient to consider Dr. E. Smith's[¶¶] researches of weavers and tailors. The two weavers were engaged in "the very laborious occupation of wide-width cocoa-matting." Applying my tables to the recorded food of these men, I find that they received a daily supply of 5·33 oz., or 2333 grains of plastic nutriment, containing 366 grains of nitrogen. As an average of twenty-six days' experiment they gave:—

702·9 grains of urea, containing	328·0	grs. nitrog.
8·52 oz. fæces, containing	40·93	,,
Total nitrogen	368·93	,,

As this differs by only three grains from the nitrogen of the ingesta, as determined independently of the experiment, the latter has obviously been done with great care.

The tailors, who were fully fed, received 4·63 oz. flesh-formers, according to my tables, containing 318 grains of nitrogen, and as an average of twenty-six days gave in egesta:—

608·4 grains of urea, containing	283·7	grs. nitrog.
6·98 oz. fæces, containing	26·43	,,
Total nitrogen	311·13	,,

These tailors were, however, overfed; for while the weavers slightly lost weight, the tailors gained about 16 oz. each during the experiment. The lesser quantity of urea in this case was a necessary result of diminished food and work as compared with the weavers.

A distinguished colleague in my University, Professor Christison, whose knowledge as a chemist does not require to be referred to, had long since the idea that work, with corresponding food, increased the urea. When he was twenty-eight years of age and remarkably vigorous, he worked for two days as a carpenter to try this problem, and in addition walked on each of these two days ten miles, at a pace of nearly five miles per hour. As a mean of the two days, he passed 845 grains of urea; but, as the process of analysis was not then by the mercury method, we may reduce it, to make it comparable to our present standard, to 800 grains. But perhaps this may be too large a deduction, as we find that Hammond, exercising himself in a similar hard way, passed 865 grains.

We may compare these instances with those recently determined in my laboratory, and which were generally made on two men in each occupation for at least two days:

Hammermen	530	grains.
Quarrymen	550	,,
Tailors	608	,,
Weavers	303	,,
Blacksmiths	695	,,
Forgemen	740	,,
Hard-working—pedestrian	800	,,

The work of the two first set of workmen is fatiguing, but not laborious. The work of a hammerer (9) is 480,000 foot-pounds, which is within the capability of a fairly fed man with 4·2 oz. of plastic food. The difficulty of getting working men to understand the value of such inquiries has considerably retarded these determinations. In the case of the two blacksmiths, the difference between the urea of Sunday and labouring days is instructive:—

		Sundays.		Labour Days.	
H.	1.	38·56 grammes.	1.	41·38 grammes.	
	2.	34·47 ,,	2.	46·69 ,,	
Mean,		36·51		44·03	
M.	1.	31·42 grammes.	1.	40·61 grammes.	
	2.	31·06 ,,	2.	49·08 ,,	
Mean,		31·24		44·84	

H. on the Saturday evening previous to the first Sunday had killed a pig and made merry with his friends—having, in fact, been drunk; hence that day's urine was probably deranged. Taking the mean, then, of the three observations, we have for

	Grammes.	Grains.
Sundays, or days of rest	32·32	499
Week-days, or days of labour	44·43	686

The difference between 686 and 695, as given in the table, is for the equivalent of uric acid.

30. It will be seen that the demand of 730 grains of urea for a man doing the hard work of 790,000 foot-pounds is not beyond what is found in many cases. In fact, it follows as a necessity, if Tables III., IV., and V. are correct returns of the food of men engaged in labour. The researches of Lehmann[*] and Ranke[†] have shown, that when much nitrogenous food is taken, an increase in the amount of urea follows. If, then, the plastic food of the adult man stands to the hard-worked labourer as 4·2 : 5·5, the urea must increase in nearly like proportion. There is now no longer any question that all the nitrogen of the ingesta is to be found again in the urine and fæces. Bischof and Voit[‡] have proved this for dogs; Henneberg[§] for cows; Voit[‖] for dogs and pigeons; Lehmann[¶] for pigs; Ranke[**] and Smith[††] for men. As this is now determined beyond doubt, it scarcely needed new experiments to prove that a labourer, eating more food than a man not working, must pass more urea than the latter. The dispute as to the effects of *luxus consumption* involved the decision of this as the common battle-field for the disputants on both sides. Thus Beigil[‡‡] found a secretion of 711 grains of urea in the case of men, when they had lived on animal food and rested, and 806 grains, under the same conditions, when they had active work. Becher found 729 grains, Lehmann 798 grains, and Ranke 1330 grains under like conditions. We need not, therefore, discuss the *questio vexata* as to whether albumen may or may not pass directly into urea, when in excess in the blood, without being built into tissue, for this is not the normal mode of nutrition. *Luxus consumption* may be a question to discuss when considering aldermanic dinners, but it can have no meaning when applied to the hard fare of the artisan, who takes no more food than is necessary for his work. The discussion, also, as to whether exercise increases the elimination of urea has little further interest for us, when we find such men as Lehmann,[§§]

[¶¶] Phil. *Trans.*, v. 151, p. 747, *et seq.*

[*] Phys. Chem., ii., p. 450.

[†] Ranke, Müller's Archiv., 1862.

[‡] Ernährung des Fleischfressers, 1860.

[§] Quoted by Voit, *infra*.

[‖] Stickstoff-Kreislauf. *Ann. des Ch. und Phar.*, 1863; Supp. Bd. 238.

[¶] Zoochemie.

[**] *Op. cit.*

[††] Phil. *Trans.*, 1862.

[‡‡] Day's Phys. Chem., p. 43.

[§§] Phys. Chem., Bd. ii., 449.

Hammond,[‖‖] Beigil,[¶¶] Speck,[*] Franque,[†] and Beneke,[‡] deciding in favour of the fact that it is increased, against the varying experiments of Voit[§] and the younger Draper[‖] on the other side. Dr. E. Smith has explained much of the anomalies of the latter physiologists, by showing that the period of the production of urea is not necessarily its period of elimination.[¶] In most of the experiments made on this subject, the heavy exercise has been taken, not with the corresponding diet, but with the old diet, and under such circumstances the increased elimination of urea from the system is sometimes retarded two days. Hammond's experiments, even upon the same diet, were, however, very conclusive. His results are as follow :—

	Urea.	Uric acid.
With no exercise .	. 487·0 grs.	24·9 grs.
Moderate „ .	. 682·1 „	13·7 „
Hard „ .	. 865·0 „	8·2 „

31. When a large amount of animal diet is the chief source of food, exercise becomes a necessity, in order to waste the tissues for the support of respiration and other vital movements. Without it the animal soon loathes the food. This is not only the experience of carnivora, but also of man. Darwin tells us that, when in the Pampas, he lived tolerably well on a meat diet, "but felt that it would only agree with me with hard exercise;" and he tells us that the Guachos, who live upon meat, eat largely of fat, probably not only for respiratory food, but also as a protection against unnecessary muscular waste, as we have explained. Sir John Richardson observed the same fact in his Arctic travels, having noticed "that when people have fed a long time solely upon lean animal food, the desire for fat becomes so insatiable that they can consume a large quantity of unmixed, and even only fat, without nausea." The hyena in confinement wastes its tissues by moving backwards and forwards incessantly in its den, and thus is able to consume its animal diet. All this shows that the normal function of nutrition is to build its plastic food into tissues, to be transformed by internal and external dynamical work into carbonic acid, water, and urea.

32. We have confined our attention chiefly to urea, because, as a representative of dynamical labour, it is not mixed up with any other kind of work, such as *opus calorificum*. Carbonic acid is a marked product of work, but then it represents the sum of two factors,—increase in dynamical and in respiratory action. Thus, a labourer, living upon our standard diet, exhales in eighteen hours' quietude, and six hours' hard work, the following quantities of carbon, in the form of carbonic acid, after deducting the carbon in urea and in fæces :—[**]

In 18 hours' quietude, 2375 grs. of carbon.
„ 6 „ labour, 3212 „ „

In one hour's work, 535 grains of carbon are exhaled as carbonic acid, of which nearly one-fourth, or 135 grains, is due to the transformation of tissue, and the rest to the increased demand of the oxygen inspired for non-nitrogenous food.

B.—*Assimilative Work, as Measured by the Secretions per Anum.*

33. The measure of the digestive or assimilative work in a man of healthy digestion is, I believe, to be found in the nitrogen of the fæces.[††] Although the alvine evacuation frequently does contain undigested food, either in cases of over-eating or of indigestion, in full health, it is difficult to find with the microscope even traces of unchanged food. Bischof and Voit could not detect any muscular fibres in the fæces of the dog, and not even fat, when that had been purposely added to the meat. Rawitz[‡‡] and other observers are of the same opinion. Hence the common notion that fæces represent the refuse of food is not supported by correct observation. Undoubtedly they contain various ingredients, nitrogenous as well as non-nitrogenous, mixed with mineral matter (Marcet).[§§]

34. The average weight of fæces secreted in health is 4·6 oz., according to Wehsarg[‖‖], or 5½ oz. (Liebig). In Ranke's[¶¶] experiments, on a mixed diet, the nitrogen excreted by the fæces is to that in the urine as 1 : 12·5. We take one-twelfth as the amount in health. But although this is the case in man, it is not so with regard to the carnivora. In Pettenkoffer's experiments with a flesh-fed dog, the nitrogen in the fæces was to that in the urine as 1 : 72; and in the still more extensive experiments of Bischof and Voit, as 1 : 76. But the ratio[*] alters when fat or starch is added to the flesh; in the first case it is as 1 : 41, and in the second 1 : 40. When the dog was fed on flesh and sugar, it was as 1 : 23·3, and on starch alone the proportion became reversed, and then the nitrogen in the fæces was to that in the urine as 2 : 1. A little consideration will explain these differences. There are four fluids engaged in the promotion of digestion. All of them contain albuminous ferments, which receive special names, as pepsin when in gastric juice, ptyalin when in saliva, pancreatine in pancreatic juice, and intestinal ferment in the juice of the intestines. But we know nothing more of their chemical composition than that they are albuminous bodies, slightly oxygenised, and in the process of change. We do know that they have different actions,—pepsin acting on albuminous bodies, ptyalin and pancreatine converting starch into sugar, and the latter fat into its acids and glycerine; but in all probability the same ferments in different conditions produce their varying effects, just as we find the gastric ferment also able to act upon fats as well as on flesh-formers[†], and the intestinal ferment combining the functions of the salivary, gastric, and pancreatic ferments. In fact, experiment tells us that alkaline gastric juice acts like pancreatic juice, and the latter, when acidified, plays the part of the former.

Referring to the proportion of nitrogen in the urine to that in the fæces of the carnivora, it is now possible to explain the apparent anomaly, that the addition of non-

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[‖‖] *Amer. Journ. Med. Soc.*, 1855 and 1856.

[¶¶] Ueber die Harn, etc., S. 42.

[*] Archiv. des Vereins für Wiss. Heilk. Bd. iv., 484, and Bd. vi., 161.

[†] Schmidt's Jahrbuch, 1856.

[‡] Nord, See Bad., 1855, p. 83.

[§] Unters. über den Einfluss der Muskelbewegung, etc., 148, *et seq.*

[‖] *New York Jour. Med.*, 1856.

[¶] The experiments of E. Smith upon prisoners working on the treadmill are perhaps the most difficult to explain, for with this heavy work there was only an increase of sixteen grains daily. They worked every alternate day, but clearly under abnormal conditions, for "their muscular system was overworked and underfed." Their food, I find, contained daily 250 grains of nitrogen, while their urine and fæces contained 280 grains. Hence the working experiment was not one of health.

[**] 220 grains of carbon are allowed for fæces, and all of which is deducted from the six hours' labour.

[††] It is only as this lecture passes through the press that I observe Marcet has given the same view, without, however, working it out. Not having found any such views in his two papers on fæces, I did not think of looking at his lecture on the chemistry of digestion till the last moment. The passage to which I refer is as follows :—"The principal object of the alvine evacuation is obviously to rid the body of certain parts of the intestinal secretions which, after having served their purpose in effecting the digestion of food, are not fit to return t the blood."—*Jour. Ch. Soc.*, xv., 418.

[‡‡] Ueber die Einfach Nährung Mittel.

[§§] *Phil. Trans.*, 1854 and 1857.

[‖‖] Mikros. Und. Chem. Untersuchg. des Fæces, 1853.

[¶¶] *Op. Cit.*, p. 311.

[*] These numbers are relative, not absolute. The fæces of flesh diet contained 6·5, of starch 4·4, of sugar 7·9 per cent. of nitrogen but the proportions of nitrogen in urine to nitrogen in fæces are as given in the text. Thus we find, on summing up the quantities, that the nitrogen in urine and in fæces, on a diet of flesh and sugar, is in grammes, as 85·22 : 3·65; on flesh, starch, and fat, as 102·46 : 2·57 and on starch alone as 5·68 : 10·26. I have omitted the fæces on bread diet, for they seem to have been chiefly undigested bread.—(Ernährung des Fleischfressers.)

[†] Marcet, Chemistry of Digestion, Chem. Soc. Jour.,

nitrogenous aliments to the diet increased, instead of diminishing, the amount of that element in the fæces. When the animal is fed on flesh free from fat, the gastric ferment alone is brought into activity, aided partially perhaps by the intestinal ferment, and the residue of these appear in the fæces, which are found to contain but little nitrogen. When fat is now added to the diet, a large amount of pancreatic juice is brought into activity, and the used-up ferment of this juice is added to that of the gastric and intestinal juices as before. Hence we find that the proportion of nitrogen in the fæces is increased. When starch is mixed with the flesh, then the salivary ferment co-operates with the other three ferments in preparing the food for assimilation, and we find the proportion of nitrogen rather greater than before. When a carnivorous animal is placed in such an anomalous position as in feeding it on starch alone a much larger quantity of salivary, pancreatic, and intestinal ferments appear to be called into action to digest this unusual and unmixed diet, and hence the amount of nitrogen in the fæces becomes increased to an unusual amount.

35. The usual amount of nitrogen in the fæces of man is 6·5 per cent. in dry and 1·7 in fresh excrement; while the carbon is from 43 to 44 per cent. in the former. This is almost identical with the composition of normal fæces in the carnivora. The reason obviously is, that the changed albuminous ferments which form the nitrogenous constituents of fæces in health are the same in both classes of animals. Just as yeast loses some of its nitrogen by work, as emulsin becomes poorer in nitrogen and richer in oxygen when it has ceased to act on amygdalin, so do these different forms of albumen in their degradation suffer like changes. A well-known experiment of Lehmann is instructive on the subject under consideration. When emulsin (the casein of sweet almonds) is introduced with amygdalin into the stomach of an animal, the well-known fermentation by which that body is converted into oil of bitter almonds and prussic acid takes place, and the animal dies. On the other hand, when emulsin alone is introduced to the stomach, and amygdalin is injected to the blood, the animal does not suffer by the experiment. But upon reversing the mode of administration, and injecting the emulsin to the blood and putting the amygdalin into the stomach, the animal dies as before. Hence, we find that the ferment, after acting upon the substances which it met with in the intestines, could not be absorbed, for had it been it would have met with amygdalin in the blood, and would have produced fatal effects. That it had acted as a ferment upon the materials in process of digestion and had become exhausted is certain, for it altogether changed in its passage, the fæces of the animal not containing any emulsin capable of acting upon fresh portions of amygdalin. No experiment could be more conclusive for our views, because emulsin is simply changed casein, as these digestive ferments are changed albumen, each having certain peculiarities of action, according to the alkaline or acid fluids with which they act, or with other varying conditions.

36. Let us now return to the proportion of nitrogen found in the alvine dejections of man; it stands in relation to that in the urine as 1 : 12. Where it is present in larger proportions than this, then the excess is probably due to undigested flesh or to an excessive secretion of ferments necessary to overcome some digestive difficulty. In other words, one-twelfth of all the plastic food taken by a man is converted into digestive ferments, and this is excreted *per anum*.

I am not inclined to agree with those physiologists‡ who consider that these ferments secreted from the blood are the degraded products of tissue-waste in their passage to urea. On the contrary, I believe them merely to be albumen of the blood, the oxygenation of which is incipient, so as to make it ready to build up tissue, as in its passage to fibrin.§ Hence, when there is an extensive demand on the blood for tissue material, as in the case of work in excess of the food supplied (for instance, as observed by E. Smith with his overworked prisoners), then the amount of the alvine dejection diminishes. These digestive ferments secreted from the blood cannot be albuminous materials in a downward career, otherwise their surplus, beyond that required for fermentation, would not again be absorbed into the nutrient fluid. It is only a small portion of the whole that is rendered unfit for re-absorption and is reduced to a degraded condition. If the great bulk of what is generally esteemed to be the ferments were not taken back into the blood, the amount of nitrogenous matter in the alvine dejections must be much greater than we find to be the case. Let us take very moderate computations as to the quantities of digestive juices secreted in twenty-four hours by a standard man, and this re-absorption will appear to be a necessity :—

1·6	kilog.	of saliva,‖	contains	2·4	grammes	ptyaline.
6·4	„	gastric juice¶	„	20·5	„	pepsin.
4·0	„	pancreatic**	„	50·8	„	pancreatin.
0·2	„	intestinal††	„	1·8	„	ferment.
		Total . . .		75·5	grammes.	

Now as the whole fæces contain only 9·4 grammes of these exhausted ferments, it is obvious enough that the larger quantity represented above cannot consist of degraded matter in its descending career. When it is further borne in mind that the daily waste of tissues in a healthy man is only 112 grammes, it is impossible for us to suppose that more than half that quantity of degraded matter is preserved in the blood, to be excreted and then re-absorbed. This view would be quite inconsistent with the admirable arrangements of the excretory organs for speedily carrying off used-up matter from the nutrient fluid.

The functions of these digestive secretions must be considered as assimilative in the largest sense of the term. Chemical affinity generally is assimilative effort. When hydrogen unites with oxygen, each element endeavours to assimilate the chemical characters of the other element to itself, and when they are equal in power neutrality results. These ferments, as they are termed, when secreted in the digestive fluids, are albuminous substances changed and fitted for assimilation in the body, and capable of preparing the ingested food to assume their own state. They meet with resistance, which their large mass enables them to overcome, but a small portion of them succumb in the conflict, and are finally excreted in the alvine dejections, along with certain non-nitrogenous materials, which have probably been used in co-operation with them to fit the calorifacient constituents of food for absorption into the blood.

ACADEMY OF SCIENCES.

May 22, 1865.

Another extract from the memoir of M. Persoz "*On the Molecular State of Bodies*" was read. The extract treats of the equivalent volumes of solid bodies, and the variations they undergo under the influence of heat.

A communication by M. Jaillard was read "*On some Derivatives of Toluidine.*" The author has found that toluidine or toluylamine, like ammonia, will give rise to

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‡ Draper's Human Physiology, p. 84.

§ Smee, *R. S. Proc.*, xii., 399, 405.

‖ Dalton's "Human Phys.," p. 96.

¶ Katherine Kutt, the Esthonian peasant, with a gastric fistula, gave no less than 30 lbs. daily; the usual estimate, however, from researches on dogs, and applying them to man, is 14 lbs.

** The estimates on this subject vary enormously, some going as high as 15 lbs. for a standard man. I have therefore taken a low estimate, nearly that of Bernard, who has devoted so much study to the pancreas.

†† I allow this for intestinal juice, from the experiments of Bidder and Schmidt.

amides, which vary according to the acids by means of which they are obtained, and which may be classed as mono-, bi-, tri-, &c., toluidides. The toluidic monamines may be prepared in the same way as the ammoniacal monamides by means of chlorides of monatomic acid radicals, and the author has formed aceto-, butyro-, valero-acid benzotoluidides. These bodies differ only in a few unimportant particulars. Toluylamine, however, differs altogether from ammonia in its behaviour with aldehydes, uniting with hydride of salicyle, for example, in the equal equivalent proportions. But with the sulphuretted essential oils (essence of mustard, for example), toluidine again behaves like ammonia. The author regards toluidine as a nitride of toluenyle and hydrogen, and names the derivatives on the same plan.

M. Georges Delvaux presented a note "*On the Action of Chromic Acid on Aniline.*" Two parts of aniline added to one part of chromic acid dissolved in eighteen or twenty parts of water forms after a time a deep brown precipitate. After digesting two or three days the precipitate may be separated by filtration; and then on treating it with boiling water a solution is obtained which dyes silk or wool a light violet red. On adding ammonia or carbonate of soda to the cold solution, a liquor is obtained, after filtration, which dyes silk and wool a yellowish red without any violet shade. The part insoluble in water appears to contain violet. The fact that this colour is soluble in alkalies without becoming decolorised seems to indicate that it is not a salt of rosaniline—an opinion which is supported by the circumstance that it is soluble in benzole. Strong hydrochloric acid also dissolves it, taking a green colour; but on the addition of water the red is restored. It dissolves in dilute hydrochloric acid, keeping its red colour.

M. Duchemin, whose "*Modifications of Bunsen's Battery*" we have noticed, wrote to say that crude chloride of potassium used in place of chloride of sodium, as he suggested in his last communication, considerably increases the power of the battery.

These were the only communications relating to chemistry read at the meeting.

NOTICES OF BOOKS.

For and Against Tobacco; or Tobacco in its Relations to the Health of Individuals and Communities. By B. W. Richardson, M.A., M.D., &c. London: Churchill and Sons. 1865.

This is, on the whole, a fair and dispassionate statement of the case for and against tobacco, and deserves the careful perusal of all devoted to the weed. Every reader of the Chemical News knows what happens when tobacco is burnt in a pipe or as a cigar, and we need not stop to notice the composition of tobacco smoke. Many too, no doubt, have felt "the first effects of tobacco on the body," to which Dr. Richardson devotes his next chapter, and will agree with him that these effects are by no means pleasant, and wonder to themselves however they came to continue the indulgence. But as they have continued it, it is well that they should know the worst about the consequences, and we accordingly condense a part of the author's summary. All the evils of smoking, he says, are functional in character, and no confirmed smoker so long as he indulges in the habit can ever be said to be well. But it does not follow that he is to become the subject of organic or fatal disease because he smokes. Smoking produces disturbances in the blood, on the stomach, on the heart, on the organs of sense, on the brain, on the mucous membrane of the mouth and throat, and on the bronchial surface of the lungs. The statement that tobacco smoke causes specific diseases, such as insanity, epilepsy, consumption, and chronic bronchitis, Dr. Richardson considers as devoid of truth. There is one affection, however—the atrophy of the optic nerve—said to be produced by tobacco smoking, of which the author has not taken sufficient notice. This effect of smoking, first pointed out by Mr. Wordsworth, was at one time strongly questioned; but more extended observation seems to have confirmed the dependence of the disease on tobacco, and we believe that now all the leading ophthalmologists in Enrope admit the existence of tobacco amaurosis. It does not follow, Dr. Richardson would say, that every smoker will become amaurotic; but still he ought to be told plainly the risk he runs; and we hope the author will give much more space to this part of his subject in another edition of his pamphlet.

We will make two more short quotations. "Put down the smokers in Great Britain at a million. . . . Why should a million of men be living with stomachs that only partially digest, hearts that labour unnaturally, and blood that is not fully oxidised? In a purely philosophical point of view, the question admits but of one answer—viz., that the existence of such a million of imperfectly working living organisms is a national absurdity—a picture suggesting a mania, foolish, ridiculous, and incomprehensible." And yet Dr. Richardson considers tobacco "the least harmful of luxuries." "It is innocuous," he says, "as compared with alcohol; it does infinitely less harm than opium; it is in no sense worse than tea and sugar; and by the side of high living altogether it contrasts most favourably." From these two somewhat opposed statements, the reader must draw his own conclusions for or against tobacco.

Chemisches Central Blatt. Nos. 20 and 21. 1865.

These two numbers contain very little that has not already been noticed. In No. 20 we find "*A Method of Distinguishing between Cotton and Linen in Mixed Fabrics,*" by Böttger. He cuts a strip of the fabric three or four inches long and one and a-half wide, and draws out the threads at the corners so as to expose the warp and the weft. He then dips the ends into a weak alcoholic solution of aniline red, washes with common water until the washings are colourless, and now places the strip, while moist, in ordinary solution of ammonia, by which the colour will be discharged from the cotton, while the linen will remain red. At the corners where the threads have been loosened, the individual cotton threads will in a short time be seen quite white, and the linen a beautiful rose red.

The only novelty we find in No. 21 is a form for spiritus chlorato-ethereus, which will be noticed among our Miscellanea.

NOTICES OF PATENTS.

1709. *Manufacture of Paints.* G. W. Webbe and F. Caut, Croxted Road, Dulwich. Dated July 9, 1864. (Not proceeded with.)

1729. *Manufacture of Pigments.* L. Schad, Hesse Cassel Dated July 12, 1864.

The first of these specifications describes the use of gas tar, or melted pitch and bitumen, as vehicles for a variety of metallic oxides and pigments when employed for coating surfaces after the manner of paint. It is intended to use only such colours as will withstand the action of heat, and those which cannot be injuriously affected by the sombre tint of the proposed vehicle.

The invention described under the second heading consists in the employment of manganate of baryta as a pigment under the name of "Cassel green." This new compound is prepared by the action of heat upon mixtures of oxide of manganese with nitrate of baryta, or preferably by heating a mixture of

Nitrate of manganese . .	24	parts.
Nitrate of baryta . . .	46	"
Sulphate of baryta . .		"

in a calcining furnace until the whole of the nitric acid is driven off, and the product assumes an uniform green colour. It is then ground in a mill, and applied as a water colour in union with five per cent. of gum arabic or dextrine. Kaolin may be used instead of sulphate of baryta, and in the same proportion as that above specified.

1727. *Apparatus for Calcining Bones, and for Reburning and Revivifying Animal Charcoal.* S. Carey, East Ham, Essex. Dated July 12, 1864.

The specification describes an improved form of retort, and mode of setting the same, in order to be enabled by such arrangement to conduct the reburning of animal charcoal, &c., as a continuous operation. The inventor uses a D-shaped clay retort of considerable length, and sets it across the furnace at an inclination of about thirty-two degrees, so that the granules of bone-black introduced at the upper extremity may descend by their own gravity, and be completely burnt or revivified by the time they have reached a closed box placed beneath the lower end of the retort.

1759. *Preparation of Material for the Purification of Gas.* A. A. Croll, Coleman Street, London. Dated July 14, 1864.

The inventor acts upon sawdust, or other vegetable matter in a fine state of division, with concentrated sulphuric acid in such a manner as to induce the carbonisation of the woody fibre. The blackened material thus obtained is very effectual in absorbing ammonia and other gaseous impurities contained in foul coal-gas, and the saturated product could be made available for the manufacture of artificial manures.

1766. *Manufacture of Fluoride of Silicium.* R. A. Brooman, Fleet Street, London. A communication. Dated July 14, 1864.

Instead of decomposing fluor spar with a strong acid in the presence of sand or other silicious mineral for the preparation of gaseous fluoride of silicium, the inventor prefers to heat the mixture of fluoride of calcium and sand with carbon for the purpose of deoxidising the silica.

1780. *Obtaining Hydraulic and other Cements from Residuums or Wastes.* T. Twindells, Wigan. Dated July 15, 1864.

The inventor proposes to economise the waste products of the alkali, iron, and chromic manufactures, by employing these materials in the production of cements. They are to be intimately mixed with lime or chalk or clay, burnt in kilns, and afterwards ground to a fine powder. It would seem possible to make the blast furnace cinder and alkali waste react upon each other at a high temperature without the addition of basic mineral matters, such as lime or clay, and so prepare at once a cheap cement fit for many rough kinds of engineering constructions.

1804. *Composition for Protecting and Preserving Metals, such as Iron, Copper, and Zinc, used in the Construction of Ships.* H. E. F. Debriou, Welbeck Street, Cavendish Square, London. Dated July 19, 1864.

The composition herein described consists of a thoroughly incorporated mixture of one part of mineral pitch with three parts by weight of vulcanised india-rubber, applied warm to the surfaces of the metal.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

1102. F. A. Abel, Woolwich, "Improvements in the preparation and treatment of gun-cotton."—Petition recorded April 20, 1865.

1126. E. S. Beaux and E. Pannifex, Rue de l'Isly, Paris, "A new process of tanning leather and other skins."—April 22, 1865.

1144. W. Clark, Chancery Lane, "Improvements in washing or steeping and bleaching textile or fibrous materials."—A communication from Messrs. Neyret, Orioli, and Fredet, Boulevard St. Martin, Paris.—April 24, 1865.

1184. A. Grainger, Hall Place, Kennington, and C. M. Girdler, Saville Row, Walworth Road, "Improvements in the production of portraits or likenesses on certain materials by means of photography."—April 27, 1865.

1220. A. H. Emerson and R. Fowler, Mildmay Park, Stoke Newington, "Improvements in the manufacture and application of glass and other vitreous compositions."—May 1, 1865.

1242. C. G. Lenk, Dresden, Saxony, "An improved process for purifying water."—May 3, 1865.

1263. S. Bennett, Church Terrace, East Lee, Kent, "Improvements in brewing, distillation, the production of vinegar, and the extract of malt and other grain."—May 5, 1865.

1266. J. Swindells, Wigan, Lancashire, "Improvements in the manufacture of coal gas."—May 6, 1865.

1274. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in safety lamps."—A communication from F. Sack, Sprockhoeval, near Elberfeld, Prussia.—May 8, 1865.

1278. J. C. C. Halkett, Cramond House, County of Mid Lothian, N.B., "An improved composition for coating iron or other vessels and for other similar purposes."—May 9, 8165.

1313. A. Parkes, Birmingham, "Improvements in the manufacture of parkesine of compounds of pyroxyline, and also solutions of pyroxyline, known as collodion."—May 11, 1865.

1391. H. Ransford, Brompton, Middlesex, "Improvements in treating rice and other grain for the manufacture of starch; also to prepare them for use as food and for other purposes."—May 12, 1865.

1361. G. Walton, Weardale Villa, Clapton, "Improvements in apparatus used in distilling hydrocarbons."—May 16, 1865.

Notices to Proceed.

112. A. J. Sax, Paris, "Impregnating air for hygienic or therapeutic purposes with the vapours or emanations arising from tar, creosote, or other suitable liquid antiseptic or anti-putrid substances, or disseminating in the air, for the said purposes, suitable pulverised substances."—Petition recorded Jan. 13, 1865.

132. H. J. Rogers, and J. M. Scholfield, Serle Street, Lincoln's Inn, "Improved means of closing the mouths of bottles or other vessels."—Jan. 16, 1865.

202. B. King, Rushmere, Ipswich, "Improvements in the manufacture of manure."—Jan. 23, 1865.

263. F. A. Laurent and J. Casthelaz, Paris, "Improvements in the manufacture of benzoic acid."—Jan. 30, 1865.

315. R. A. Brooman, Fleet Street, London, "An improved varnish for preserving wood, and for protecting iron ships and other metal work from oxidation and from fouling."—A communication from A. Guibert, Paris.—Feb. 4, 1865.

448. J. F. Hersey, Park Place, Brompton, "Improved apparatus for measuring the specific gravity of liquids."—A communciation from E. Payne, Montreal, Canada.—Feb. 16, 1865.

CORRESPONDENCE.

Continental Science.

Paris, May 30.

An account of the great storm which broke over the valley of Escaut on the 7th of this month, communicated to the Academy by M. Lermoyer, seems to me to deserve notice, since I never remember having read of any fall of hail at all equal to what seems to have fallen on this occasion. The mass of stones which accumulated on the ground was soon sufficient to obstruct the course of the water from the torrents of rain which also fell, and the two formed a rolling wave, at least two metres in height, that rushed down the slopes of the valley, carrying everything before it. The canal that receives the drainage was completely obstructed by an enormous pile of charcoal which was swept into it. The next day M. Lermoyer found in the bed a deposit of hailstones 460 metres long, 20 metres wide, and in places more than 5 metres deep, thus forming a mass of more than 40,000 cubic metres, so compact that the water passing over it did not diminish the thickness one millimetre in twenty-four hours. It was, in fact, a solid glacier, on which he could walk with safety. Further on he found the ground covered (for 2 kilometres) with a bank of hailstones 200 metres wide, which must have contained 600,000 cubic metres, and which had not disappeared six days after the storm. No hail fell on this spot, and this enormous deposit consisted of stones brought by the floods and arrested by the banks, hedges, trees, and cottages. The devastation committed by the storm is immense: the crops, to translate literally, are completely hashed up, and, in fact, the whole soil has been washed away.

I find in *Les Mondes* an extract from the report of the Government Commission appointed to examine Dr. Louval's process for the preservation of corn, flour, and biscuits. Everybody knows what these are exposed to. Flour will, under some circumstances, heat and turn sour, weevils and cockroaches will attack biscuits, and rats and mice will seriously diminish the profits of the farmer if he will allow them. Dr. Louval's plan is remarkably simple. He puts the substances into iron cylinders and exhausts the air. Here, of course, they are safe from rats and mice; but is flour preserved from fermentation, and are biscuits kept free from weevils? The experiments of the Commission are most conclusive on these points. It is proved that weevils cannot exist in rarefied air, and that no fermentation can take place in the flour. It has been found also that in the particular apparatus devised by Dr. Louval a good vacuum can be maintained for six months, and the Commission therefore reports that the process is of a kind to render great service to commerce and the mercantile marine. Perhaps the process may be worthy the attention of our Government also; for if I remember rightly, the Clarence Yard, Portsmouth, is always familiarly spoken of by sailors as "Weevil."

I am tempted to make another extract from *Les Mondes*. It is from a letter by Father Hamy to the Editor, accompanying a translation of the article on Equivalents in Mr. Watts' Dictionary. The rev. gentleman speaks in the highest terms of this excellent work, and hopes the able Editor will make known "a dictionary so complete, so well executed, and calculated to be useful, not to say indispensable, to all who cultivate the glorious science of chemistry." Mr. Watts' friends—and they include all English chemists—will be pleased to learn that his work is so highly appreciated here.

MISCELLANEOUS.

The Case of Poisoning near Maidstone.—We learn that the poison taken in this case was really nitrobenzole. What remained in the bottle was sent to Dr. Letheby for examination, and has been found to be pure nitrobenzole. It is only fair to the druggist who sold it to say that the bottle was distinctly labelled "Oil of almonds, for scenting pomatum;" but we think it would be safer to discontinue calling nitrobenzole, oil of almonds. Essence of Mirbane is more appropriate, and free from danger.

Royal Institution.—The following are the arrangements for the ensuing week:—Monday, June 5, at 2 o'clock, General monthly meeting. Tuesday, June 6, at 4 o'clock, Mr. Edwin Chadwick "On the Physical and Moral Condition of the English Wage Classes." Thursday, June 8, at 4 o'clock, M. Jules Simon "On the Physical and Moral Condition of the English Wage Classes." Friday, June 9, at 8 o'clock, Professor Frankland, F.R.S., "Latest Researches in Organic Chemistry." Saturday, June 10, at 4 o'clock, M. Jules Simon "On the Physical and Moral Condition of the English Wage Classes."

Spiritus Chlorato-ethereus is prepared by mixing in a retort three-quarters of a part of finely powdered bichromate of potash and one part commercial hydrochloric acid. To this is carefully added, so as to mix as little as possible with the acid, sixteen parts of the strongest spirit of wine. Heat is then applied, and fourteen parts distilled. The first ounce should be rejected; the remainder will be free from acid, and show, on the addition of nitrate of silver, only a trace of chlorine.—*Neues Jahrb. für Pharm.*, Feb., 1865.

Use of Aniline Colours in Oil and Aquarelle Painting.—Kletinsky dissolves the aniline colour in strongest alcohol, saturates this solution with Dammar resin, filters the tincture, and pours the filtrate either on pure water or solution of common salt, stirring well all the time. The water or solution must be at least twenty times the bulk of the tincture. The coloured matter separated can now be collected on a filter, washed, and dried. It can then be ground with linseed oil, poppy oil, or oil varnishes. —*Chem. Central-Blatt*, No. 13, 208.

Discovery of Cannel Coal in New South Wales. —Advices have been received, by the last overland mail, of the discovery, about 80 miles from Sydney, near a line of railway now in course of construction, of a workable seam of cannel coal, which surpasses the hitherto unrivalled Boghead in richness. Its yield per ton is reported to be 17,500 cubic feet of gas of 31-candle illuminating power, and ·745 specific gravity. The discovery must exercise great influence on gas-lighting in Australia, the East Indies, China, California, and South America, by enabling the gas-works of those countries to use their inferior local coals, and bring up the quality of their gas to a satisfactory illuminating power by the addition of a small quantity of Australian cannel.—*Journal of Gas Lighting.*

ANSWERS TO CORRESPONDENTS.

⁂ In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. X. of the Chemical News, containing a copious Index, is now ready, price 11s. od., by post, 11s. 6d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. XI. commenced on January 6, 1865, and will be complete in 26 numbers.

Will appear in an early number, a lecture by Dr. Letheby, "On the Present State of the Chemistry of Gas-Lighting, chiefly in relation to the properties of the individual constituents of coal-gas, and the best means of consuming it for lighting and heating purposes."

W. B.—Dr. Odling's lectures will be begun in our next volume, and completed in the volume.

T. R.—Published by Baillière, Regent Street.

G.—Mr. Huggins' lecture will appear in our next.

X. Y.—The dose was excessive, and you were justified in applying to the writer of the prescription.

W. A.—The smallest dose of nitrobenzole that will kill has not been determined. The smaller the dose, the longer the symptoms are delayed. Dr. Letheby's paper will be found in the *Proceedings* of the Royal Society.

Received.—Dr. W. Bird Herapath; Wm. Herapath, sen.; Chas. Piesse.

Book Received.—Pratt's Astronomical Investigations.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

An Introduction to Chemical Philosophy, according to the Modern Theories, by ADOLPHE WURTZ, *F.R.S.*

PART I.

EQUIVALENTS, ATOMIC WEIGHTS AND MOLECULAR WEIGHTS.

SECTION II.—*New System of Atomic Weights.*

(*Continued from page 182.*)

Discussion of Ampere's Law.—All the arguments used to determine the molecular weights of volatile compounds have for their basis the law of Ampère, that *equal volumes of gases or vapours contain the same number of molecules*. It is admitted that the molecule of simple and compound bodies corresponds to 2 volumes, and that consequently tho molecular weight was given by their double density in respect to hydrogen.

There are exceptions to this law. The molecules of perchloride of phosphorus, of hydriodate of phosphuretted hydrogen, of hydrochlorate and hydrocyanate of ammonia, of monohydrated sulphuric acid, and certain other combinations, correspond to 4 volumes of vapour; their molecular weights are expressed by four times their vapour densities compared with hydrogen.

MM. Hermann Kopp,* Cannizzaro,† and Kekulé,‡ have proposed the following interpretation in order to bring these exceptions into the general rule. At the temperature at which the vapour densities of the preceding compounds are taken they decompose, and instead of being a homogeneous vapour, they consist, in fact, of a mixture of vapours. Thus, perchloride of phosphorus PCl_5 splits up into protochloride $PCl_3 = 2$ volumes, and into $Cl_2 = 2$ volumes. Sal ammoniac NH_4Cl splits up into $HCl = 2$ volumes and $NH_3 = 2$ volumes; sulphuric acid SH_2O_4 into $SO_3 = 2$ volumes and $H_2O = 2$ volumes, and the same for the other compounds. But this decomposition is not definite; when the temperature lowers the original combination becomes re-formed in such a manner that after the condensation of the vapour there no longer remains a trace of the *dissociation* § which it has undergone.

The idea is ingenious, but the demonstration is difficult. In fact, how can it be proved that the vapour of perchloride of phosphorus, for example, consists at 300° of a mixture of chlorine and protochloride? Shall the chlorine be absorbed by some body with which it can combine? Then another affinity comes into play, and however feeble this be, it may be thought that it plays an active part in the decomposition of perchloride of phosphorus. For this reason, M. Bunsen remarked that the question as to whether two gases existed in the state of combination or of mixture could only be settled by submitting these gases to physical tests. They might thus be allowed to diffuse into another gas—hydrogen, for instance; if they were combined, they would pass through in the proportions in which they existed in the combination; if they were mixed, they would pass as if each were by itself in the inverse ratio of the square roots of their densities.

These experiments have been tried. M. Pebal‖ was the first to show that when the vapour of sal ammoniac is diffused into hydrogen, the ammonia, being less dense than the hydrochloric acid, passes through in greater quantity.

More recently, Messrs. Wanklyn and Robinson¶ have found that when the vapour of hydrated sulphuric acid is allowed to diffuse into air through a very fine point, water escapes abundantly, whilst anhydrous sulphuric acid accumulates in the flask. Having in a second series of experiments substituted perchloride of phosphorus for sulphuric acid, they found that the flask after some time contained a small quantity of protochloride of phosphorus, the vapour of which, being denser than that of chlorine, diffused less easily. The accuracy of the hypothesis of MM. Hermann Kopp and Cannizzaro thus appeared to be demonstrated, but some new and important experiments of M. H. Deville** have reopened the question.

This physicist found that the vapour of water would decompose in small quantity at a temperature lower than that developed by the combination of hydrogen with oxygen, and therefore much lower than that at which water would decompose in quantity. He assumed, therefore, that bodies possess at temperatures below their decomposing point a certain tendency to decompose—a tension of decomposition, as he expresses it. It is this nascent decomposition which he now calls dissociation. This is an apt interpretation of the experiments of MM. Pebal, Wanklyn, and Robinson. By virtue of their tension of decomposition, sal ammoniac, sulphuric acid, and protochloride of phosphorus undergo an incipient decomposition at the temperatures at which they vaporise, and it is these minute portions so dissociated which give rise to the phenomena of diffusion just mentioned.

This was an interpretation, but the following is an experiment which carries great weight:—††

Having led ammonia and hydrochloric acid into a flask heated by the vapour of mercury and furnished with an air thermometer, the temperature of the receptacle was seen to rise to 394·5° by the action of the combination of the two gases. M. Deville concluded from this that hydrochlorate of ammonia could exist in the state of vapour at the temperature of 350°, and even at 390°, and that this vapour does not consist of a mixture, but actually of a combination of the two gases—ammonia and hydrochloric acid.

Against this conclusion MM. Wanklyn and Robinson have raised the following objections:—As M. Deville passed the gas rapidly into the flask where they were to combine, nothing proves that at the moment of combination they had acquired the temperature of 350°. Therefore, being cooler than the receptacle, they were able to combine at a temperature below that which is needed for the dissociation of sal ammoniac; and this combination would, therefore, have produced an elevation of temperature. Quite true, replies M. Deville to this; but it must be remembered that the temperature

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[*] *Annalen der Chemie und Pharmacie*, cv. 390.

[†] *Nota sulle Condensazioni di Vapore.* An appendix to the above quoted work of M. Cannizzaro, *Sunto di un Corso di Filosofia Chimica.* Pisa, 1858.

[‡] *Annalen der Chemie und Pharmacie*, cvi. 143.

[§] The word dissociation is due to M. H. Deville (*Comptes Rendus*, xlv. 857, 1857). In its original sense it was almost synonymous with decomposition. More recently M. Deville has employed it to indicate the partial and gradual decomposition which bodies undergo when exposed to a temperature below that at which they decompose in bulk, and which is their true temperature of decomposition. I have proposed (*Répertoire de Chimie Pure*, ii. 37, 1860) to employ this appropriate term dissociation to characterise the temporary disjunction which certain bodies undergo at elevated temperatures into elements which are ready to recombine when the temperature becomes lowered.

[‖] *Annalen der Chemie und Pharmacie*, cxxiii. 199, and *Annales de Chimie et de Physique*, 3rd series, lxvii. 93.

[¶] *Comptes Rendus*, lvi. 547.

[**] *Comptes Rendus*, lvi. 195.

[††] *Comptes Rendus*, lvi., 193.

rose to 394°. The gases combine, therefore, at 350° with development of heat. It follows, therefore, that sal ammoniac is not dissociated at 350°, but that it really exists in the state of combination, and not in the state of mixture.

There can be no mistaking the force of these arguments.‡‡ However, the ingenious theory of M. H. Deville—or rather, the conclusions which he draws from it—still leaves room for an objection which I shall next discuss.

(To be continued.)

On the Action of Ammonia on Carbon at a Red Heat, by *Dr.* G. Lunge.

Allow me to make some remarks on a short paper by M. Weltzien—"The Formation of Cyanogen and the Action of Ammonia on Carbon at a Red Heat"—contained in the last number of the Chemical News.

It is stated therein, that according to M. Kuhlmann, ammonia acts on carbon, giving cyanide of ammonium and marsh gas; the author, however, believing that the reaction could not be so simple, and that ethylene and acetylene were formed at the same time, repeated the experiment, but failed in obtaining any carbonated hydrogen.

Now, I have worked on a large scale, for manufacturing purposes, the process of passing ammonia over red-hot charcoal. I collected the cyanide of ammonium in earthenware receivers, containing sometimes a solution of caustic soda, sometimes recently precipitated protoxide of iron and other unstable materials, in order to fix the cyanogen, then the ammonia was fixed by muriatic acid in similar receivers. The unabsorbed gas had to pass through one or two casks partially filled with water, the conducting pipes dipping into the latter; at last it went back to the heating furnace and was burnt there. An exhausting pump was working between the last cask and the furnace, as the earthenware pipes which contained the charcoal could not have withstood the pressure of so many columns of liquor in the different earthenware and wooden receivers. Most of the connecting pipes between the receivers were made of earthenware, only one or two of copper, just those in connexion with the wooden casks. No sooner had I commenced to work this appratus, when I experienced daily violent explosions, some of which shattered the wooden casks to pieces, leaving the earthenware receivers intact. Every precaution had been taken against such an emergency, and I was quite at a loss to understand the cause of it until I met with a notice of spontaneous explosions in copper gas pipes from an American paper. Besides, it was already known then (1860) that illuminating gas, when passed through a solution of protochloride of copper, leaves therein a compound of detonating properties. (Acetylene itself was not then discovered—or, at least, M. Berthelot had not published his discovery.) Consequently I exchanged the copper pipes for iron ones, and the explosions ceased directly. Considering the circumstances, I have been led to believe that acetylene was formed in the above described process, and that this gas, coming in contact with the copper pipes, caused the explosions.

I think there is nothing extraordinary in this discrepancy of results, M. Weltzien working in a chemical laboratory, and I on a manufacturing scale, when many of the circumstances would be quite different, and the reactions likely to be more complicated.

Wolverhampton, June 5.

On the Properties of Liquefied Hydrochloric Acid Gas, by George Gore, *Esq., F.R.S.*[*]

[The apparatus employed and manipulation adopted in procuring liquid hydrochloric acid were similar to those by means of which the author procured liquid carbonic acid; and are described at length in the *Journal* of the Chemical Society, vol. xv., p. 163. The materials used to obtain the gas were strong sulphuric acid and fragments of sal ammoniac.]

The liquid acid is a very feeble conductor of electricity, but is not nearly so powerful an insulator as liquefied carbonic acid gas.

The following experiments illustrate its chemical, solvent, or other action upon various substances immersed in it. The quantity of the solid substances employed was in nearly all cases very small in proportion to that of the liquid acid in contact with them, and in many cases did not amount to one-twentieth of its volume.

A piece of charcoal remained unchanged at the end of ten days, the acid being in a liquid state in contact with it at intervals. A fragment of fused boracic acid did not lessen in bulk or alter in appearance in seven days. White phosphorus was undissolved and unchanged in nine days, and remained equally inflammable. A fragment of ordinary sulphur did not dissolve or alter in several days. Fragments of vitreous black selenium did not dissolve or change in six days. Iodine dissolved rather freely, and quickly formed a purple-red solution. A piece of pentachloride of phosphorus softened in the gaseous acid, and dissolved quickly and completely in the liquid acid, forming a colourless solution. A fragment of sesquicarbonate of ammonia swelled and became full of fissures in the gaseous acid, but neither evolved gas nor dissolved when the liquid acid came into contact with it; after three days' intermittent immersion in the liquid acid, the saline residue evolved no gas on immersion in dilute hydrochloric acid. A piece of sal ammoniac, immersed almost constantly during nine days, remained undissolved and unchanged.

Potassium evolved no gas when the liquid acid came into contact with it; after eight days it was sometimes enlarged in bulk, and from the outset it was of a white colour; it did not at all dissolve. In a second experiment the results were precisely similar; after three days' intermittent immersion the saline residue showed no signs of containing free potassium on immersing it in dilute hydrochloric acid. Anhydrous carbonate of potash in powder evolved no gas on first coming into contact with the liquid acid; after three days' occasional immersion it remained undissolved, and the residue evolved no carbonic acid on immersion in dilute hydrochloric acid. A crystal of chloride of potassium did not dissolve or change in appearance by four hours' immersion in the liquefied acid. Powdered chlorate of potash imparted a yellow colour to the liquid acid, and did not lessen in bulk during three days' constant immersion; the upper gutta-percha stopper became quite white at its inner end. A crystal of nitrate of potash became of a brownish colour

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[‡‡] Another argument of M. H. Deville is this:—Hydrocyanate of ammonia is a very stable body; it forms at 1000°. It can, therefore, exist at this temperature, which is above that in which ammonia is decomposed into hydrogen and nitrogen. If, then, its vapour density is determined at 100°, it is found to correspond to four volumes. Can a body then be decomposed at 100° when it is capable of forming at 1000°?

[*] Abstract from *Proceedings* of Royal Society, p. 204.

before the gas liquefied, and remained undissolved after six days' intermittent immersion; the upper gutta-percha stopper was unusually acted upon, and of a nankeen colour.

Sodium became white and swelled largely before the gas liquefied. No visible gas was evolved by it in the liquid acid. After three days' intermittent immersion the residue contained no sodium in the metallic state, and no portion of it imparted a blue colour to damp litmus paper. Anhydrous carbonate of soda in powder immersed one hour and a quarter in the liquid acid evolved no visible bubbles of gas, and lost its alkaline reaction (with litmus paper) to about three-fourths of its depth. A fragment of fused sulphide of sodium produced a slight sublimate of a yellowish-white colour. It evolved no visible gas in the liquefied acid.† After three days' variable immersion it was of a yellowish-white colour, and somewhat enlarged in bulk; the residue evolved no sulphuretted hydrogen by immersion in dilute hydrochloric acid, and its solution gave a perfectly white precipitate with acetate of lead, and imparted no dark colour to sulphate of copper.

Precipitated carbonate of baryta in powder evolved no visible gas by immersion in the liquid acid; it remained undissolved and unchanged in appearance during three days' immersion; the residue evolved a minute quantity of gas by contact with dilute hydrochloric acid. Precipitated carbonate of strontia in powder behaved like carbonate of baryta; the residue, after three days' immersion, was lost during the discharge. A minute fragment of anhydrous Bristol lime exhibited no solution or alteration by nearly constant immersion during eight days in the liquid acid. On removal from the tube, it imparted a strong blue colour to neutral litmus paper by slight friction. On fracture it was found similarly alkaline throughout, and exhibited a slight change of colour, extending from its surface to the centre, as if the gas or liquid had been forced into its pores. In a second experiment of three days' intermittent immersion, precisely similar effects were obtained. Several minute fragments of very soft marble were immersed in the liquid acid at intervals during seven days. No gas was evolved when the liquid touched them. On removal from the acid, their physical characters appeared unaltered; they were insoluble in water, but quickly dissolved in dilute hydrochloric acid, with copious evolution of gas. A fragment of bone-earth did not dissolve or alter in appearance during seven days.

Bright magnesium ribbon slowly became dull in the liquid acid without visible evolution of gas; after seven days' intermittent immersion it was still, with the exception of a thin film, in the metallic state. In a second experiment of three days' constant immersion similar effects occurred; the residue dissolved and floated in dilute sulphuric acid, with copious evolution of gas. A wire of magnesium and one of platinum immersed in the liquid acid, and connected with a sensitive galvanometer, evolved no perceptible electric current, and only a barely perceptible current after two days of constant immersion. Calcined magnesia in powder did not dissolve or alter in appearance during four days' nearly constant immersion. Oxide of cerium (containing some oxide of didymium and lanthanum) remained undissolved and unchanged in colour during nine days; the residue was insoluble in water. Metallic aluminium became dull in the gas, and quickly dissolved, with evolution of gas, when the liquid acid came in contact with it, and formed a colourless solution. A wire of aluminium and one of platinum, immersed $\frac{1}{8}$th of an inch apart in the liquefied acid, and connected with a sensitive galvanometer, produced a steady deflection of 12½ degrees, the aluminium being positive. The deflection gradually increased to 17 degrees in one hour, and two layers of liquid formed, the lower one brown in colour, and the upper one nearly colourless. The conductivity of the liquid acid was probably increased by the metallic aluminium dissolved in it. Precipitated alumina did not visibly alter or dissolve during six days; the residue deliquesced in damp air. Precipitated silica in powder did not dissolve or visibly alter during four days. Precipitated titanic acid in powder (pale flesh colour) slightly dissolved in seven days.

A fragment of fused tungstate of soda did not alter in bulk during ten days; it had then acquired a superficial green colour. Molybdic acid in powder turned dark green, but remained undissolved at the end of nine days. Native sulphide of molybdenum remained undissolved and apparently unchanged during two days. Molybdate of ammonia in powder became yellowish green in the gas; it became grass green in colour in the liquefied acid, but did not dissolve in four days. Sesquioxide of chromium in powder did not dissolve in six days, but became of a dull blackish-brown colour. A fragment of anhydrous yellow chromate of potash became red before the gas liquefied, but did not dissolve or otherwise alter in the liquid acid. Sesquioxide of uranium became of a pale yellow colour in the gas, but did not dissolve in the liquid acid in six days; the residue was entirely soluble in water. Precipitated black oxide of manganese in powder, and free from water, became quite white in the gas; it remained white in the liquid acid without evolving visible bubbles of gas, and did not lessen in bulk in seven days. A crystal of permanganate of potash softened and swelled in the liquid acid, but did not dissolve in five days; it remained of a dark colour; the residue, placed in distilled water, produced no colouration.

A crystal of metallic arsenic remained perfectly bright and unchanged in bulk during three days' immersion. Arsenious acid in powder quickly liquefied in the gas, and dissolved to a colourless solution in the liquid acid. A crystal of arsenic acid softened before the gas liquefied, and dissolved quickly and freely in the liquid acid to a colourless solution. Bisulphide of arsenic in powder did not dissolve in six days, but became slightly less red and more yellow; a slight yellowish-white sublimate occurred in the tube during the generation of the gas. Teriodide of arsenic in powder slightly dissolved to a purple-red liquid; apparently only a trace of its iodine was extracted, as its bulk was not visibly less in three days. A crystal of bright antimony remained perfectly bright and unchanged after nine days' intermittent immersion. Precipitated teroxide of antimony became partly liquid before the gas liquefied; it dissolved in the liquid acid quickly and rather freely, and made a colourless solution. A fragment of precipitated antimonic acid did not dissolve in six days. A fragment of black tersulphide of antimony evolved a film of yellowish-white sublimate, and lessened in bulk before the gas liquefied; it decomposed and dissolved in the liquid acid in about a quarter of an hour, and formed a colourless solution, which exhibited no further change during seven days. A fragment of bright metallic bismuth remained undissolved and unchanged in the liquid during three days.

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† Probably the sulphuretted hydrogen set free was in a liquid state, and therefore no bubbles of gas appeared. I found by experiment that hydrochloric acid and hydrosulphuric acid, generated together and condensed into a liquid state, did not form two separate strata of liquid.

Bright zinc evolved no visible gas in the liquid acid, and was not perceptibly corroded in three days. Oxide of zinc slowly dissolved in seven days. Metallic cadmium evolved no gas in the liquid, and was not sensibly corroded in three days. Precipitated carbonate of cadmium evolved no visible gas in the liquid acid, and remained undissolved and unchanged in appearance during seven days. Yellow sulphide of cadmium evolved a trace of white sublimate before the gas liquefied; in the liquid acid it became quite white, and remained undissolved in seven days; on removal it was hard in texture and quite white throughout, and evolved no odour of sulphuretted hydrogen or separation of sulphur on treatment with strong nitric acid. Bright tin evolved no visible gas in the liquid acid; after ten days' intermittent immersion it was converted, to some depth of its substance, into a bulky white solid with deep fissures. In a second experiment of three days' immersion similar results occurred; all the tin was corroded except a minute fibre in the centre, the white solid was imperfectly soluble in water, but instantly soluble in dilute hydrochloric acid. Binoxide of tin in powder did not dissolve in seven days; the residue was white and insoluble in water. A crystal of protochloride of tin softened before the gas liquefied, and partly dissolved in the liquid acid in four days. Bright metallic thallium evolved no gas in the liquid acid, and was only superficially blackened without further corrosion after three days' immersion. Metallic lead did not evolve visible gas in the liquefied acid; it became blackened at first, and in ten days was corroded deeply to a white substance. Red oxide of lead quickly became white in the liquid acid, but did not dissolve in seven days; it was then quite hard, white throughout, and not readily soluble in water. Precipitated carbonate of lead evolved no visible gas in the liquid acid, and remained undissolved after three days' immersion; the residue evolved no gas by contact with dilute hydrochloric acid. Precipitated sulphide of lead in powder produced a faint film of white sublimate in the gas, and by a few hours' immersion in the liquid acid became wholly white; it did not dissolve during seven days, and was then quite white throughout, and not readily soluble in water. Yellow iodide of lead did not dissolve in seven days, but became of a purplish brick-brown colour and evolved a strong odour of free iodine; it produced yellowish-brown stains upon paper. Yellow chromate of lead evolved at first (in the gaseous acid) a small quantity of deep-red vapour, which condensed as a red moisture near it on the tube; the chromate became white in the gas, and did not dissolve in the liquid acid in three days; it was then a soft white solid, not freely soluble in water, and imparted a faint greenish tint to water.

A minute fragment of iron remained bright, and evolved no gas when the liquid acid came into contact with it; after nine days of intermittent immersion it was only slightly tarnished, and on removal from the acid was found otherwise unaltered. A fragment of fused sulphide of iron produced a faint film of whitish sublimate at first, but evolved no bubbles of gas on contact with the liquid acid; it did not dissolve or alter in appearance. A second fragment constantly immersed during three days behaved similarly; it was as hard as before immersion, and evolved sulphuretted hydrogen freely in hot dilute sulphuric acid. A crystal of green vitriol became yellowish white and opaque in the liquid acid, but did not diminish in volume in six days; the residue was a soft opaque yellowish-white solid. Oxide of cobalt in powder exhibited no change or solution during three days; on removal it was found to be very hard, of a light-brown colour, and dissolved in water, producing a pink solution with separation of black oxide. Peach-coloured carbonate of cobalt evolved no visible gas in the liquid acid; it became greenish blue, but did not lessen in bulk in three days; the residue became pink in the air, and dissolved almost completely in water, forming a pink liquid; it also dissolved in dilute hydrochloric acid without evolving bubbles of gas. Anhydrous chloride of nickel did not dissolve in the liquid acid in six days. Metallic copper soon lost its brightness in the gas; it evolved no gas in the liquid acid, and was only slightly corroded after seven days. Black oxide of copper became of a lighter colour in the liquid acid, but did not lessen in bulk in seven days; the residue was a greenish and yellowish white powder, which instantly turned black in water, forming a pale-blue solution, and left black oxide of copper. A crystal of blue vitriol became of a light brown colour in the liquid acid, but did not dissolve in six days; on removal it was found to be a brown soft solid. Protoxide of mercury became white in the gas, and did not dissolve by constant immersion in the liquid acid in four days; the residue was a white solid soluble in water. Vermilion in powder slowly changed in the liquid acid in three days to a pinkish-white solid, but did not dissolve. Scarlet iodide of mercury in powder imparted a red colour to the liquid acid, but did not lessen in bulk or change in colour during three days; the residue lost its red colour on the application of heat. A fragment of protochloride of mercury did not visibly alter in the liquid acid in four days. Metallic silver did not dissolve or become much corroded during seven days. Oxide of silver became white in the liquid acid in one day, but not dissolve. Precipitated chloride of silver in powder did not visibly alter or dissolve during sixteen days. Metallic platinum was unaffected in the liquid acid.

Solid extract of litmus dissolved slightly, forming a faintly purple blue or inky solution; it became of a dark red colour, and enlarged in bulk; the residue formed a perfect solution in water; the solution was red colour,

Remarks.—The foregoing experiments show that liquid hydrochloric acid has but a feeble solvent power for solid bodies in general. Out of 86 solids it dissolved only 12, and some of those only in a minute degree; of 5 metalloids it dissolved 1—viz., iodine; of 15 metals it dissolved only 1—viz., aluminium; of 22 oxides it dissolved 5—viz., titanic acid, arsenious acid, arsenic acid, teroxide of antimony, and oxide of zinc; of 9 carbonates it dissolved none; of 8 sulphides it dissolved 1—viz., tersulphide of antimony; of 7 chlorides it dissolved 2—viz., pentachloride of phosphorus and protochloride of tin; and of 7 organic bodies it dissolved 2.

The results show also that liquid hydrochloric acid in the anhydrous state manifests much less chemical action upon solid bodies than the same acid when mixed with water as under ordinary circumstances; for instance, the difference of its action upon magnesium, zinc, cadmium, and even aluminium, under the two conditions, is very conspicuous. This may arise in a great measure from its feeble solvent capacity—insoluble films forming upon the surface of the bodies immersed in it preventing its continued contact and further action. This want of contact could hardly have been the case in the remarkable instance of caustic lime: here was a powerful and true acid (*i.e.*, a hydrogen acid) and a powerful base; each in a nearly pure state; both possessing under ordinary circumstances a very powerful chemical affinity for each other; the one a liquid and the other a porous solid; the solid base being very small in bulk, and the liquid acid largely in excess, probably fifty times the quantity necessary for its saturation; and the action extended over a far greater period of time than would in the presenbe of water been at all necessary, nevertheless no perceptible chemical action occurred; the two remained totally uncombined.

It must not be overlooked that the results are partly due to anhydrous hydrochloric acid in the liquid state, and partly to the same acid in the gaseous state, under great pressure, the one class of effects not being eliminated from the other in the present experiments; it is probable that if the substances could have been submitted to the action of the liquid acid alone, the chemical effects would have been much smaller even than they were. For instance, the action upon potassium, sodium, and tin appeared to be due to the influence of the acid in the gaseous state, as no gas was perceptibly evolved by these metals in the liquid acid. In the cases of potassium and sodium (the latter in particular) it is perhaps possible, though highly improbable, that the whole of the metal had been corroded before the liquid acid touched it; but with tin this was certainly not the case, some metallic tin being left uncorroded at the end of the experiment.

Oxides in general, with the exception of lime and certain others which do not readily combine with aqueous hydrochloric acid, were slowly converted in a greater or less degree into chlorides. Carbonates also, except that of lime, were in general converted in a greater or less degree into chlorides.

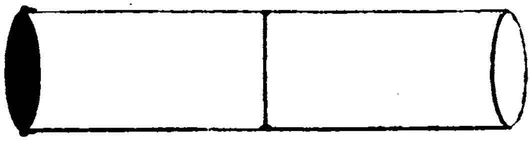
Such carbonates as were decomposed evolved no visible bubbles of gas in the liquid acid; this may be explained on the supposition that they were previously completely decomposed by the gaseous acid during the process of generation (this, however, was not the case with carbonate of soda), or that the liberated carbonic acid was in the liquid state and was dissolved by the liquid hydrochloric acid. In my former paper it was shown that liquid carbonic and hydrochloric acids generated and condensed together did not form two separate strata of liquid.

Sulphides were in some cases converted into chlorides; in other cases not so; in nearly all cases a trace of whitish sublimate was produced in the gaseous acid. The chlorate and nitrate of potash were both decomposed.

PHYSICAL SCIENCE.

Diffusion of Gases through India-rubber and Biscuit-ware, by G. F. Ansell.

In the course of my experiments upon the subject of indicating the presence of fire-damp in coal mines, I have made a curious observation, which I desire to record, because I am just now too much occupied with other matter to continue that subject. I have found that gases diffuse through india-rubber somewhat slowly, and it is well known that they diffuse rapidly through biscuit-ware. I have found that if a glass cylinder be intercepted at its middle by a plate of biscuit-ware securely cemented in, and that then one end of the cylinder be covered with a thin sheet of india-rubber, and diffusion allowed to proceed through the india-rubber, the gas (coal-gas in a very marked degree) which has diffused through the india-rubber, remains between that substance and the biscuit-ware, exerting considerable force, although the other end of the cylinder be perfectly open to the atmosphere.



The reason of this is somewhat obscure, but I am inclined to think that it will be found in the existence of two forms of the same gas (mine gas, for example), one which will permeate india-rubber but not biscuit-ware, and *vice versa*. My other experiments take all my spare time, but so soon as they are finished—and they are now rapidly coming to a close—I shall investigate the facts above recorded.

Royal Mint, June 2.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 1.

Professor A. W. Williamson, *Ph.D., F.R.S., Vice-President, in the Chair.*

The minutes of the previous meeting were read and confirmed, and the donations to the Society's library, which included the Actonian Prize Essay of Mr. George Warington, were duly acknowledged. Mr. George B. Robertson and Mr. Edward Swann were formally admitted Fellows of the Society, and Mr. William A. Tilden, of the Pharmaceutical Society's laboratory, was duly elected by ballot. The names of Mr. James Parkinson, Royal School of Mines, and Mr. Frederick Rowe, Colchester, were proposed for the first time.

Professor Williamson then invited the President, Dr. W. A. Miller, to favour the Society with his promised discourse upon "*Some Points in the Analysis of Potable Waters*," which he was glad to see admitted of experimental illustration.

Dr. Miller prefaced his remarks by a brief statement, to the effect that it must not be supposed that the whole subject would be treated under a novel aspect; there were certain points of novelty involved in some of the methods which he proposed to bring forward, but at the same time he desired to discuss with his colleagues the old modes of analysis, many of which might be beyond criticism, whilst others appeared to the speaker open to serious objection. He referred particularly to the determination of the so-called "organic matter" in waters, and it was with the view of insuring greater uniformity in operating and in reporting the analytical results that he was anxious to introduce the subject for general discussion. In order to exhibit the principle of the permanganate method of determining oxidisible organic matter, Dr. Miller commenced with a comparative experiment upon "filtered Thames" and distilled waters, to equal portions of which were added a small quantity of mineral acid (sulphuric or hydrochloric), and measured portions of a standard solution of permanganate of potassium dropped in from a small graduated pipette; at the end of half an hour the first had become perfectly bleached, while the pure water had not in the least degree altered the pink colour of the permanganate. It was proposed to add successive doses of the reagent by ten or twenty grains measure at a time, until on standing fifteen minutes at the ordinary temperature the colour of the solution was no longer discharged. The results obtained by such a mode of proceeding were truly comparative, if not in themselves absolute, expressions of the amount of organic matter dissolved in the water. Before commencing the analysis a physical examination of the sample of water might first be made, and for a judgment of the colour it was convenient to look through a stratum of two feet in length, as proposed by Dr. Letheby. [The long glass tubes fitted with flat plates at the lower extremity were exhibited.] Water examined in this way showed a yellow, green, or brownish tinge when compared side by side with pure distilled water, and with a white reflecting surface beneath. With regard to the taste of water, Dr. Clark pointed out many years ago the advantage of raising the temperature of the sample to 80° or 85° F., when differences of flavour not appreciable in the cold water became at once apparent. The odour might be noted under the same circumstances, particularly after addition of baryta to liberate the ammonia. For the estimation of the amount of sediment half a gallon of the water might be passed through a tared filter, dried, weighed, and afterwards incinerated for the purpose of deducing the proportions of organic and mineral matters originally held in suspension. The determination of "hardness" by Dr. Clark's soap-test gave a result of practical interest; the precautions had been so fully described, both by the inventor and by Mr. Dugald Campbell, that he had only a single recommendation to offer—viz., that it was necessary to boil the water for at least an hour before testing its hardness in comparison with that of the water in its natural condition. In conducting this operation of boiling, Dr. Miller made use of a long (three-feet) length of glass tubing, the lower extremity of which was cut off obliquely, and just above this point the tube was expanded into a bulb, which might be conveniently rested in the neck of an ordinary flask, and would be sure to fit close enough to prevent the escape of aqueous vapour during the ebullition, and the tube would serve to condense the whole of the steam.

Determination of Organic Matter.—Allusion having been made to the difficulty of insuring exact results by the incineration process, the lecturer proceeded to describe the conditions under which he usually operated. If a water contained much carbonate or chloride of magnesium, it was quite useless to evaporate it to dryness *per se*, for at the temperature at which the organic matter in the dry residue would be destroyed, much of the acid constituents of these magnesium compounds would also be driven off. To avoid errors from this source, it was advisable to add a known weight of perfectly dry carbonate of sodium—say, four or five grains of the alkaline salt to two deci-gallons of the water—before carrying the evaporation to dryness; then heat the dry residue to 280° F. (or not above 300° F.), weigh, and ignite to burn off the organic matter. This process should be conducted at the lowest visible heat, and a platinum capsule with tight-fitting lid could be employed with advantage. At this stage the saline residue would have lost an appreciable amount of carbonic acid, which should be restored by moistening the mass with an aqueous solution of that substance, again evaporating and drying the residue at 280° F., or better, at the identical temperature employed in the first instance. An exposure for one hour in the air bath was sufficient to drive off the water contained in the hydrated sulphate of lime, besides all traces of moisture. The difference between the weights before and after ignition was usually expressed as "organic matter," but the speaker was not satisfied with this definition, nor did he place much reliance upon the indications afforded by this method of operating. Referring to the experiment on the table, Dr. Miller entered into a full description of the permanganate test, and stated that it was due to Forchhammer, who proposed its adoption fourteen or fifteen years ago. The quantity of water usually taken for this purpose was eight fluid ounces, or one twentieth part of a gallon, to which was added thirty drops of concentrated hydrochloric acid (or a smaller amount of sulphuric acid), and by degrees the permanganate solution as already explained. The latter was prepared by dissolving 3·95 gr. of the pure crystallised permanganate of potassium in 10,000 gr. of pure water, and the solution was consequently equivalent to $\frac{1}{10000}$th of its weight of oxygen. To make sure of the correctness of the standard, the permanganate was checked by a freshly prepared solution of 7·875 grains of crystallised oxalic acid in 10,000 grs. of water. Incidentally, it was mentioned that oxalic acid in aqueous solution gradually underwent a change, and slowly absorbed atmospheric oxygen. The mode of employing the permanganate having been demonstrated, Dr. Miller further remarked that different experiments made upon the same water gave sufficiently concordant results; and although this chemical reagent did not enable the analyst to discriminate between the different kinds of organic matter, it would be found, as a rule, that the bodies most dangerous and objectionable in water were at the same time those which were most readily destroyed. The amount of organic matter by weight could not, therefore, be inferred from the known volume of permanganate required to effect its destruction; but the results were indicative of the amount of oxidisable substances in solution, and the quality of the water could be judged from a number of comparative trials. It had been objected that nitrites and possibly other reducing agents affected this test; but he found no difficulty in distinguishing between nitrites and organic matter, inasmuch as the lower oxides of nitrogen instantly reduced the permanganate and organic matter only after an interval of time, so that it was easy to go on adding the pink solution until the colour became permanent, and then afterwards observe the action due to organic matter alone. The test for nitrites proposed by Dr. D. S. Price was very delicate; its action was shown by mixing a few drops of iodide of potassium with dilute sulphuric acid and a little starch, and then on adding the water a blue colour was immediately developed in the event of nitrites being present. Nitric acid was frequently present in waters, and could be readily estimated by Dr. Pugh's excellent method, which was based upon the conversion of an acid solution of protochloride of tin into bichloride at the expense of the oxygen in the nitrate. The pressure tubes should be only three-fourths filled with the liquid, and merely heated for a short time to 340° Fahr. in an air bath; being then opened, the contents were washed out and tested by a standard solution of bichromate of potassium, for the purpose of ascertaining the amount of protochloride of tin yet remaining. The employment of Mohr's burette with Erdmann's float left nothing to be desired on the score of volumetric accuracy, and the bichromate was allowed to flow in until a mixture of iodide of potassium and starch previously added to the stannic solution became blue.

The conclusion of Dr. Miller's discourse and the discussion which followed are unavoidably postponed until next week.

The meeting was adjourned until Thursday, June 15, when Dr. Frankland and Mr. Duppa will give an account of their researches "*On the Transformation of Lactic into the Acrylic Series of Acids.*"

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, May 19.

On the Physical and Chemical Constitution of the Fixed Stars and Nebulæ.

By William Huggins, *Esq., F.R.A.S.*

The speaker commenced with a few preliminary remarks on the peculiar relation in which the heavenly bodies stand to man. It is alone from these lights shining upon us from distant space that we can obtain any knowledge of the parts of the universe which are without the earth. The experimentalist who seeks to bring to light the truths which lie hidden beneath terrestrial phenomena, can subject the object of his research to each other's influence and to the various forms of force; but the astronomer is left to the indications afforded by the sense of sight alone, for the interpretation of the heavens. The distances, magnitudes, and relative motions of the sun, moon, and planets have been obtained with great exactness, but in an important respect our knowledge of the heavenly bodies was at fault. Until quite recently we possessed no knowledge from observation of the structure and chemical constitution of the sun, the fixed stars, and the nebulæ. Fortunately, for the increase of our knowledge, the cause of failure lay not in that the light of these bodies is wanting in sufficient indications of their nature, but in that the unaided eye has no power to perceive the indications by which the light of each of the heavenly bodies is specially distinguished.

Newton opened the way to a knowledge of these unperceived qualities of light. He was the first to show that by the refractive power of a prism of glass the component rays of a beam of light could be separated and presented to the eye as a band of blending colours. Wollaston and Fraunhofer discovered that the colours of the spectrum of solar light are not continuous, but are interrupted by transverse linear spaces where the light is wanting. In these lines of darkness of the solar and stella spectra, the chemical nature of the sun and stars stands written in cypher, but for half a century the lines of Fraunhofer remained uninterpreted.

In 1859 Kirchhoff announced the law by which these dark lines can be deciphered. He immediately applied his method of interpretation to the light of the sun, and discovered in that body the presence of several of the elementary forms of matter which enter into the composition of the earth.

The speaker stated that it was his intention on this occasion to bring before the members of the Institution the results of the extension of this method of analysis by the prism to the heavenly bodies other than the sun. These researches have been carried on in his observatory during the last three years; and in respect of the greater part of these observations—viz., those on the moon, the planets, and the fixed stars, he has had the great pleasure of working conjointly with his distinguished friend, Professor W. A. Miller.

The speaker then referred briefly to the principles of spectrum analysis, upon which their interpretation of the phenomena observed in the spectra of the heavenly bodies was based, stating that spectra may be arranged under three orders—viz. :—

1. A continuous spectrum unbroken by bright or dark lines, which indicates that the light has not undergone any modification on its way to us. Also that its source is an opaque body, almost certainly in the solid or liquid state. Such a spectrum gives no information of the chemical nature of the substance from which the light emanates.

2. A spectrum of bright lines separated by dark spaces; this informs us that the source of the light is matter in the gaseous state. By a comparison of the bright lines of such a spectrum with the lines of terrestrial flames we may discover whether any of these terrestrial substances exist in the distant and unknown source of light. The spectra of many of the nebulæ are of this order.

3. A continuous spectrum interrupted by dark lines; this shows that the light has passed through vapours which have deprived it of certain refrangibilities by a power of selective absorption.

Since Kirchhoff has shown that these dark lines agree exactly in position with the bright lines which the vapours would emit if in a luminous state, a comparison of these dark lines with the bright lines of terrestrial vapours will indicate whether any of these are present in the vapours through which the light has passed. The spectra of the fixed stars are of this order. In the case of these bodies, the vapours that produce the dark lines immediately surround them, and are those of the substances of their surfaces. The chemical constitution of the stellar atmospheres will correspond, at least in part, with that of the stars themselves.

The speaker then described the special form of apparatus by which he and Professor Miller have compared the spectra of the stars by a method of simultaneous observation, with the spectra of many of the terrestrial elements.[*]

This apparatus is adapted to the eye-end of an achromatic telescope of eight inches aperture. The telescope is mounted equatorially, and follows the star to which it is directed by means of an accurately adjusted clock-motion.

The point of light which a star forms in the focus of the object-glass is lengthened in one direction only by a cylindrical lens. The short line of light falls upon a narrow slit, and the diverging rays are rendered parallel by an achromatic lens. They are then refracted by two prisms of dense flint glass of 60°. The spectrum is viewed with a small achromatic telescope which is carried by a micrometer screw. By means of this the observer can measure with great precision the position of the stellar lines relatively to those of the solar spectrum.

The spectra for comparison were obtained from the spark of an induction coil taken between electrodes of various metals. Sometimes a wire of platinum surrounded with cotton and moistened with a solution of the substance required was employed. The light from the spark is reflected by a small moveable mirror upon a reflecting prism covering one-half of the slit. By this arrangement the spectrum of the star and the spectrum of the metal compared with it are seen in juxtaposition, and the coincidence or the relative position of a dark line in the stellar spectrum with a bright line in the metallic spectrum can be determined with very great precision. These comparisons are observations of great delicacy, and can be satisfactorily made on the finest nights only.

Results of the Observations on the Moon and Planets.

Moon.—Limited portions of the moon's surface were examined under varied conditions of illumination. As yet no strongly marked modification of the solar light has been detected, which would indicate a lunar atmosphere of considerable extent. The mode of disappearance of the spectrum of a star, when occulted by the moon, is negative as to the existence of an atmosphere about the moon.

Jupiter.—Several lines in the spectrum of Jupiter indicate a powerful absorption by the atmosphere of this planet. These were compared with the lines of our atmosphere. The atmosphere of this planet contains some of the gases or vapours present in our atmosphere, but it is not identical with it in constitution.

Saturn.—The observations of this planet are less certain because of the feebleness of its light. Some of the lines produced by its atmosphere appear to be identical with those seen in the spectrum of Jupiter.

Mars.—The lines characterising the atmospheres of Jupiter and Saturn are not present in the spectrum of Mars. Groups of lines appear in the blue portion of the spectrum, and these by causing the predominance of the red rays, may be the cause of the red colour which distinguishes the light of this planet.

Venus.—All the stronger lines of the solar spectrum were seen in the brilliant light of Venus, but no additional lines indicating an absorptive action of the planet's atmosphere.

In the case of most of the planets the solar light is probably reflected not from the planetary surface, but from

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[*] It is upon this method of direct comparison that the trustworthiness of the results which they have obtained chiefly depends. In this respect, too, their observations stand alone. In 1815 Fraunhofer recognised several of the solar lines in the spectra of the Moon, Venus, Mars, and four of the fixed stars. In 1862 Donati published diagrams of three or four lines in fifteen stars. Recently Secchi, Rutherfurd, and the Astronomer Royal have given diagrams of the positions, obtained by measurement only, of a few strong lines in several stars.

clouds at some elevation above it; under such circumstances the light would not be subjected to the absorbent action of the lower and denser portions of the planet's atmosphere, which are precisely those of our atmosphere, which are most effectual in producing the so-called atmospheric lines.

Results of the Observations on the Fixed Stars.

Since these bodies are self-luminous, we may hope to gain by prismatic analysis more information of their nature, than it is possible to do of the planets which all shine by reflecting the sun's light.

What are the stars? Endeavour with the most powerful telescopes to approach them, still they assume no apparent size; they remain under the highest magnifying powers what they appear to the unaided eye, diskless, brilliant points.

Until quite recently, our knowledge of the stars might be summed up thus:—That they shine; that they are immensely distant; that the motions of some of them show them to be composed of matter endowed with a power of mutual attraction.

Photographs of drawings of the spectra of several stars were projected on a screen by means of the electric lamp. In these were seen the coincidences and relative positions of the dark lines of the stars with the bright lines of the elements which which had been compared with them.

The results on the light of the stars Aldebaran and α Orionis (Betelgeux) are given in the following table:—

Elements Compared with Aldebaran.

Coincident.

1.	Hydrogen	with	lines C and F
2.	Sodium	„	double line D
3.	Magnesium	„	triple line *b*
4.	Calcium	„	four lines
5.	Iron	„	four lines and E
6.	Bismuth	„	four lines
7.	Tellurium	„	four lines
8.	Antimony	„	three lines
9.	Mercury	„	four lines

Not coincident.

Nitrogen	three lines
Cobalt	two lines
Tin	five lines
Lead	two lines
Cadmium	three lines
Barium	two lines
Lithium	one line

70 lines measured.

Elements Compared with α Orionis (Bertelgeux).

Coincident.

1.	Sodium	with	double line D
2.	Magnesium	„	triple line *b*
3.	Calcium	„	four lines
4.	Iron	„	three lines and E
5.	Bismuth	„	four lines
6.	Thallium?		

Not coincident.

Hydrogen	C and F
Nitrogen	three lines
Tin	five lines
Lead	two lines
Gold?	
Cadmium	three lines
Silver	two lines
Mercury	four lines
Barium	two lines
Lithium	one line

80 lines measured.

The 70 or 80 lines measured represent some of the stronger only of the numerous lines which are seen in the spectra of these stars. Some of these are probably due to the vapours of other terrestrial elements which have not been compared with these stars. It would be assumption to suppose that the sixty-five so-called elements constitute in its entirety the primary material of the universe. Doubtless in the spectra of the stars the chemist is introduced to many new elements—would that it were possible for him to recognise and to isolate them!

It is a very suggestive fact that the lines of hydrogen corresponding with C and F of the solar spectrum are wanting in the spectra of α Orionis and β Pegasi, and in these two stars only, out of more than fifty stars examined,

β Pegasi	contains	sodium, magnesium, perhaps barium.
Sirius	„	sodium, magnesium, iron, hydrogen.
α Lyræ (Vega)		sodium, magnesium, iron.
Pollux	„	sodium, magnesium, iron.[†]

No stars sufficiently bright to give a spectrum have been observed to be without lines. Star differs from star alone in the grouping and arrangement of the numerous fine lines by which their spectra are crossed.

The dark lines of absorption are strongest in the spectra of stars the light of which is tinted with yellow or red. In white stars the lines, though equally numerous, are very fine and faint, with the exception of the lines of hydrogen which are relatively very strong. This suggests a peculiar condition of the investing atmospheres of white stars; a modification depending possibly upon their high temperature.

A comparison of the spectra of stars which differ in the colour of their light suggested the opinion that the colours of the stars have their origin in the chemical constitution of their atmospheres.

Since the source of the light of the stars is intensely heated solid (possibly liquid) matter, the light at the time of emission would be white alike in all the stars.

The colours of the spectrum in which the lines of absorption are most closely grouped would be subdued in power relatively to the other colours, which would then predominate in the light of the star. This opinion is supported by the different arrangements of the lines in the spectra of the orange and blue components of the double star β Cygni.

From the additional knowledge which these spectrum observations give us, we are entitled to conclude that in plan of structure the stars closely resemble the sun. The source of their light is probably solid matter,[‡] in a highly incandescent state. Around this photosphere, there exists an atmosphere of vapours of such of the elements of the stars as are volatile at their high temperature.

A community of matter appears to exist throughout the visible universe, for the stars contain many of the elements which exist in the sun and earth.

It is remarkable that the elements most widely diffused through the host of stars are some of those most closely connected with the living organisms of our globe, including hydrogen, sodium, magnesium, and iron. May it not be that, at least, the brighter stars are like our sun, the upholding and energising centres of systems of worlds, adapted to be the abode of living beings?

Results of the Observations on the Nebulæ.

Besides the stars, the heavens are mottled over with feebly shining cloudlike patches and spots, often presenting strange and fantastic forms. Between 5000 and 6000

[†] The spectra of the following stars have also been examined:—Castor; ε, ζ, and η Ursæ Majoris; α and ε Pegasi; α, β, γ Andromedæ; Rigel, η Orionis; α Trianguli; γ and ε Cygni; α, β, γ, ε, and Cassiopeiæ; γ Geminorum; β Canis Minoris; β Canis Majoris; Spica, γ, δ, and ε Virginis; α Aquilæ; Cor Caroli; β Aurigæ; Regulus, β, γ, δ, ε, ζ, and η Leonis.

[‡] The phenomenon of the solar spots appears to show that the solid matter of the sun's photosphere exists in a finely-divided state, and may be compared to the carbon in an ordinary gas-flame, or to the cloud of phosphoric acid when phosphorus is burnt in oxygen. The sun's surface consists of this matter separated into masses, which are neither uniform in size nor regular in form; they may be compared to clouds.

of these so-called nebulæ are known. What is the nature of these strange objects? Dense swarms of suns melted into one mass by their enormous distance? Chaotic masses of the primordial material of the universe? The telescope alone would fail to give answers to these questions, and the analysis by the prism of objects so feebly luminous appeared hopeless.

In August last the speaker directed his telescope, armed with the spectrum apparatus, to a small but comparatively bright nebula, 37 H. iv. His surprise was great to observe that in place of a band of coloured light, such as the spectrum of a star would appear, the light of this object remained concentrated in three bright bluish-green lines, separated by dark intervals. This order of spectrum showed the source of the light was luminous gas. The brightest of the three lines has a position in the spectrum about midway between *b* and F. More refrangible than this line, and separated from it by a dark interval, a fainter line occurs. The third and faintest line coincides with F, and with a line of hydrogen. The brightest line agrees in position with the brightest of the lines of nitrogen. The line intermediate in refrangibility does not correspond with any of the elements compared with it.

NEBULÆ,

The Spectrum which indicates Gaseity.		*The Spectrum of which is Continuous.*	
37 H. iv. 6 Σ 73 H. iv. 51 H. iv. 1 H. iv. The great Neb. in Orion.	Three bright lines.	92 M. 50 H. iv.	
		31 M.	Great Neb. in Andromeda.
		32 M. 55 Andromeda. 26 H. iv.	
18 H. iv.	A fourth faint line also.	15 M. 2 M.	
Annular Neb. in Lyra Dumb-bell Neb.	The brightest line only.		

A careful examination of different portions of the Dumb-bell nebula, and of the great nebula in Orion, showed that both these nebulæ are uniform in constitution throughout; the light from one part differs from that of another in intensity alone.

The nebulæ 37 H. iv. and 73 H. iv., in addition to the bright lines, give a faint continuous spectrum: this was proved to be due to the light of the nucleus.

These observations appear to authorise the following opinions of the nature and structure of those of the nebulæ which gave a spectrum of bright lines.

1. The light from these nebulæ emanates from intensely heated matter existing in the state of gas. This conclusion is corroborated by the great feebleness which distinguishes the light from the nebulæ. A circular portion of the sun's disk subtending 1′ would give a light equal to 780 full moons, yet many of the nebulæ, though they subtend a much larger angle, are invisible to the naked eye.§§ Upon the earth, luminous gas emits a light which is very inferior in splendour to incandescent solid matter.

2. If these enormous masses of gas are luminous throughout, the light from the portions of gas beyond the surface visible to us would be in a great measure extinguished by the absorption of the gas through which it would have to pass. These gaseous nebulæ would, therefore, present to us little more than a luminous surface. This consideration may assist in explaining the strange apparent forms of some of the nebulæ.

3. It is probable that two of the constituents of these nebulæ are the elements, hydrogen and nitrogen, unless the absence of the other lines of the spectrum of nitrogen indicates a form of matter more elementary than nitrogen. The third gaseous substance is at present unrecognised.

4. The uniformity and extreme simplicity of the spectra of all these nebulæ oppose the opinion that this gaseous matter represents the "nebulous fluid" suggested by Sir William Herschel, out of which stars are elaborated by a process of subsidence and condensation. In such a primordial fluid all the elements entering into the composition of the stars should be found. If these existed in these nebulæ, the spectra of their light would be as crowded with bright lines as the stellar spectra are with dark lines.

The supposition can scarcely be entertained that the three bright lines indicate a more primary and simple condition of matter; for then, if the process of elaboration into stars be now taking place, we should expect to find in some of the nebulæ, or in some parts of them, a more advanced state towards the formation of the separate elements of which we now know the stars to consist. Such an advance would be indicated by an increased number of bright lines. It is difficult to suppose that the excessively high temperature of the nebulæ keeps in check affinities by which, if unrestrained, the formation of the elements would take place; for in some of the nebulæ a nucleus exists, which from its continous spectrum, its greater brightness, and apparent separation from the surrounding gas, we must regard as containing solid or liquid matter. At a temperature at which matter can become liquid or solid (though from peculiar conditions that temperature may be a very exalted one) we cannot suppose the formation of the chemical elements to be restrained by excessive heat.

5. A progressive formation of some character is suggested by the presence of more condensed portions, and in some nebulæ, of a nucleus. Nebulæ, which give a continuous spectrum, and yet show but little indication of resolvability, such as the great nebula in Andromeda, are not necessarily clusters of stars. They may be gaseous nebulæ, which by the loss of heat or the influence of other forces have become crowded with portions of matter in a more condensed and opaque condition.

6. If the observations of Lord Rosse, Professor Bond, and others are accepted in favour of the partial resolution of the annular nebula in Lyra, and the great nebula in Orion into discrete bright points, these nebulæ must be regarded not as simple masses of gas, but as systems formed by the aggregation of gaseous masses. Is it possible that the permanence of general form of these nebulæ may be maintained by the motions of these separate masses?

7. The opinion of the enormous distance of the nebulæ from our system, since it has been founded upon the supposed extent of remoteness at which stars of considerable brightness would cease to be separately visible in our telescopes, has no longer any foundation on which to rest in reference at least to those of the nebulæ which give a spectrum of bright lines. It may be that some of these are not more distant from us than the brighter stars.

8. As far as the speaker's observations extend, they appear to be in favour of the opinion that these nebulæ are gaseous systems possessing a structure and a purpose in relation to the universe altogether distinct from the great cosmical masses to which the sun and the fixed stars belong. What is this special purpose? Many fascinating theories present themselves in connection with the great problems of the conservation of the energy of the universe, and of the source and maintenance of solar and stellar heat. In the opinion of the speaker, science will be more advanced by the slow and laborious accumulation of facts than by the easier feat of throwing off brilliant speculations.

ACADEMY OF SCIENCES.

May 29, 1865.

M. PASTEUR presented a note "*On the Deposits which Form*

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§§ See "Outlines of Astronomy," by Sir John F. W. Herschel, p. 646. Seventh Edition.

in Wines," of which he recognises three kinds. The first is a deposit of crystalline bitartrate of potash or tartrate of lime, or a mixture of the two. The second, which adheres to the sides of the bottles, is oxidised colouring matters. These two are deposited in sound wines, but the third, which falls in sick wines, consists of cryptogamic vegetation. The author believes that wines are greatly improved by the influence of oxygen, and recommends that they should be left in casks, and bottled as they are wanted. He is speaking, it must be remembered, of French wines.

M. Kuhlmann presented the fifth part of his memoir "*On the Crystallogenic Force.*" In this part he says that he ought to speak of the crystallisation of supersaturated solutions, but that part of the subject he passes over for the present, expressing an opinion, however, opposed to MM. Viollette and Gernez, that the intervention of a small quantity of the same saline matter is indispensable for such crystallisations. There are one or two matters of practical interest in the paper to which we shall return, and now only quote a few remarkable examples of the crystallisation of metals and metalloids. A solution of sulphide of arsenic in ammonia after some months deposits arsenic in a crystalline state, and with a metallic lustre. Part of the metalloids become oxidised, and sulphate or arseniate of ammonia is formed. A crystal of sulphate of copper placed in a solution of polysulphide of potassium soon becomes covered with sulphide of copper, on which rhombohedric crystals of sulphur deposit. Crystals of calomel placed in a solution of monosulphide of potassium get converted into crystallised cinnabar. Gold may be obtained in beautiful crystalline spangles by placing a solution of the chloride contained in a porous vessel in a solution of ferrous sulphate, hyposulphite of soda, or oxalic acid. Large crystals of sulphate of copper placed in a solution of monosulphide of potassium, he found to become coated with sulphide of copper, underneath which he found crystals of metallic copper, with sulphate of copper in their interiors, and around them a double salt of copper and potassium.

Another part of the memoir of M. Persoz, "*On the Molecular State of Bodies,*" was read. The part relates to boiling points of liquids, which he considers to depend on their molecular volumes.

M. Lallemand presented a note "*On Ammoniacal Cyanide of Copper,*" in reply to MM. Schiff and Becchi (see *ante*, p. 21). The results obtained by these three chemists do not agree, and M. Lallemand naturally thinks that they experimented upon different compounds, none of which, as the matter now stands, are of much interest.

M. Cahours communicated some "*Researches on the Sulphuretted Radicals.*" The author points out that sulphur has a strong tendency to form with radicals of different alcoholic series, compounds of the type

$$S_2\left\{\begin{matrix}X_3\\R\end{matrix}\right.$$

corresponding to sulphurous acid or the hypothetical compound S_2H_4, in which three of the equivalents of hydrogen will be replaced by alcohol radicals, while the fourth will be substituted by a metalloid radical. He remarks also that while sulphur and oxygen present manifest analogies in their chemical functions; there are, nevertheless, cases in which we notice in their molecular properties differences which it is impossible to explain. Sulphydric acid and aqueous vapour present, under numerous circumstances, the strictest analogies. Various alcohols and ethers are derived from the second, just as mercaptans and sulphydric ethers are obtained from the first. But if we compare the boiling points of the different products derived from sulphydric acid, we notice that as one or two molecules of hydrogen are replaced by an alcohol radical, the boiling point rises with the complexity of the molecule of hydrocarbide substituted, while in the case of products derived from water, the boiling point is lower than that of water until the compound C_8H_9 is introduced. The author gives a table illustrating this, from which we quote one or two instances:—

$$\left.\begin{matrix}H\\H\end{matrix}\right\} O_2 = 4 \text{ vols. boils at } 100°. \qquad \left.\begin{matrix}H\\H\end{matrix}\right\} S_2 = 4 \text{ vols. boils at } -73°.$$

$$\underbrace{\left.\begin{matrix}C_2H_3\\C_2H_3\end{matrix}\right\}}_{\text{Methylic ether.}} O_2 = 4 \text{ vols. boils at } -18°. \qquad \underbrace{\left.\begin{matrix}C_2H_3\\C_2H_3\end{matrix}\right\}}_{\text{Sulphydromethylic ether.}} S_2 = 4 \text{ vols. boils at } +41°.$$

$$\underbrace{\left.\begin{matrix}C_6H_7\\C_6H_7\end{matrix}\right\}}_{\text{Propylic ether.}} O_2 = 4 \text{ vols. boils at } +70°. \qquad \underbrace{\left.\begin{matrix}C_6H_7\\C_6H_7\end{matrix}\right\}}_{\text{Sulphydropropylic ether.}} S_2 = 4 \text{ vols. boils at a much higher temp.}$$

NOTICES OF BOOKS.

Poggendorff's Annalen der Physik und Chemie. No. 4. 1865.

The number opens with an article by C. Rammelsberg, "*On the Composition of Manganese Ores, and their Specific Gravity.*" The author has investigated principally the composition of the natural oxides of manganese, and his results with the more common minerals are as follows:—

1. *Pyrochroite.*—Hydrated manganous oxide, $MnO + aq$.
2. *Braunite.*—Manganic oxide, Mn_2O_3, sometimes with silicate and sometimes with a certain amount of iron in place of manganese.
3. *Manganite.*—Hydrated manganic oxide, $Mn_2O_3 + aq$.
4. *Hausmannite.*—Mn_3O_4, or $MnO + Mn_2O_3$.
5. *Pyrolusite.*—Peroxide of manganese, MnO_2.

The author discusses the constitution of the higher oxides, and seems to regard them as compounds of manganous oxide with peroxide.

In a paper on "*Forests and Weather*" Dr. Berger relates a number of thermometrical observations made to determine the influence of wooded spaces on temperature, &c.

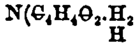
An article "*On Meteorites,*" by C. Buchner, gives an account of various specimens in well-known collections and museums.

The remaining papers which have not appeared in the Chemical News are by R. Thalen, "*On the Determination of the Limits of Elasticity in Metals;*" by J. Stefan, "*An Experiment on the Nature of Unpolarised Light, and the Double Refraction of Quartz;*" and by J. Müller "*On the Wave Length of the Blue Indium Line,*" which the author has determined to be 0·000455 min.

Annalen der Chemie und Pharmacie. May. 1865.

There is but little to notice in this number. The first paper is by Heintz, "*On the Extraction of Cæsium and Rubidium Compounds in a Chemically Pure Condition.*" The process is applicable to extraction of the rarer alkalies from the mother liquor of the Nauheim springs. The author finds that a boiling dilute solution of chloride of platinum added to a boiling solution (rather dilute) containing potassium, rubidium, and cæsium will precipitate the latter metals with but a very small proportion of the first. The platinum being removed from this precipitate, the alkaline metals are again brought into dilute solution as chlorides; the solution is heated to boiling, and once more a dilute solution of chloride of platinum is added in two portions. After each addition the liquor is filtered, while boiling, through a water-bath filter, and the precipitate is washed with hot water; the solution is then allowed to cool and deposit. In this way three precipitates are obtained; the first contains nearly all the cæsium, the second almost all the rubidium, and the third, deposited on cooling, is for the most part the potassium compound. By repeating these precipitations the compounds may be almost completely separated. In the end the author recommends that the chlorides should be converted into tartrates, and further purified by Bunsen's process.

The next article is by Teuchert, "*On Succinaminic Acid*"



$$N\left.\begin{array}{r}(C_4H_4\Theta_2.H_2\\ H\end{array}\right\}\Theta$$

obtained by the action of caustic baryta on *succinimide*, and some salts of that acid.

A paper which physiological chemists will read with much interest is Dr. Eichwald, "*On Mucin*," a contribution to the chemistry of tissue-formed substances. The remaining papers call for no notice.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

1174. W. H. Smith, Haverstock Hill, Middlesex, "Improvements in photographing upon wood, and in the preparation of wood, canvas, silk, glass, and other substances for the purpose of receiving and retaining impressions."—Petition recorded April 26, 1865.

1336. G. H. Ogston, Mincing Lane, London, "Improvements in the manufacture and reburning or revivification of animal charcoal."—May 13, 1865.

1373. R. A. Brooman, Fleet Street, "An improved method of securing corks or stoppers in bottles."—A communication from G. Bonsignes, Reims, France.—May 18, 1865.

1385. T. Richardson, Newcastle-upon-Tyne, and M. D. Rücker, Leadenhall Street, "Improvements in obtaining certain compounds of nitrogen and of sulphur."

1386. W. Davey, Hackney Wick, Middlesex, "Improvements in apparatus for washing or purifying coal gas, and for producing ammoniacal water therefrom."—May 19, 1865.

1393. J. A. Coffey, Gracechurch Street, London, "Improvements in distilling apparatus."—May 20, 1865.

1405. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "An improved apparatus for freezing, iceing, and cooling liquids."—A communication from H. N. Ballemagre, Paris.

1409. R. Müller, Weiden, Bavaria, A. T. Weld, Gravesend, and J. F. Powell, Hyde Park, Middlesex, "Improvements in the preparation of materials for animal charcoal."—May 22, 1865.

1412. H. Wilde, Manchester, "Improvements in the production and application of electricity."

1413. I. Holt, W. Holt, J. Holt, and J. Maude, Bolton, Lancashire, "Improvements in dyeing and sizing cotton, silk, woollen, and other yarns."—May 23, 1865.

1420. J. Dale and A. Paraf, Manchester, "Improvements in calico and linen printing."—May 24, 1865.

Notices to Proceed.

194. E. Atkinson, Old Bond Street, Westminster, "An improved apparatus for containing and dispersing scents and other liquids."—Petition recorded Jan. 23, 1865.

226. A. A. Croll, Coleman Street, London, "Improvements in the purification of coal gas."—Jan. 26, 1865.

249. V. Burg, Paris, "Improvements in filtering apparatus."

250. W. E. Newbon, Chancery Lane, "Improvements in the rectification of alcohol, and in the apparatus to be employed therein."—A communication from A. A. Foubert, Rue St. Sebastien, Paris.—Jan. 28, 1865.

413. G. Harton, Kentish Town, Middlesex, "Improvements in waterproofing skins, hides, and leather."—Feb. 14, 1865.

796. W. M. Williams, Caergwrle, near Wrexham, Denbighshire, "Improvements in apparatus for the distillation of coal and peat, and such other substances as are or may be used for the manufacture of solid and liquid volatile hydrocarbons, or for the manufacture of the said hydrocarbons and coke."—March 22, 1865.

1102. F. A. Abel, Woolwich, Kent, "Improvements in the preparation and treatment of gun-cotton."—April 20, 1865.

1220. A. H. Emerson and R. Fowler, Mildmay Park, Stoke Newington, "Improvements in the manufacture and application of glass and other vitreous compositions."—May 1, 1865.

1263. S. Bennett, East Lee, Kent, "Improvements in brewing, distillation, the production of vinegar, and the extract of malt and other grain."—May 5, 1865.

CORRESPONDENCE.

Continental Science.

Paris, June 5.

A curious paragraph appears in the Vienna weekly medical journal. It is to the effect that the foreign physicians who have gone to St. Petersburg to study the Russian epidemic can get no information whatever on the subject. They are said to have been extremely well received and to be *fêted*, but everything relating to the disease is studiously concealed from them. They can't get at patients to watch the symptoms, and they can't get into a deadhouse to see a post-mortem. How far this is true remains to be seen, but appearing in the journal I have named, it bears the stamp of some authority.

The *mètre* is in danger. There is on the Continent an International Geodesic Association, originally founded, it is said, to extend the knowledge of and to develope the metrical system of France. The German astronomers, however, who have measured the arc of the circle which separates Leipsic from Berlin, have convinced themselves of the inaccuracy of the mètre, and wish to adopt the toise as the unit of length. Their reasons for this choice are not given in the paper from which I quote, and I have not had the opportunity of seeing the report of the secretary of the Association, Herr Forster, Director of the Berlin Observatory. Doubtless the Association can show good reasons, although for ordinary and practical purposes the toise would seem too long for an unit. At all events, this movement on the part of the Germans should make English people hesitate before they adopt a system which a few years may see abandoned for scientific purposes.

I read in *Cosmos* that some curious chemist has analysed some of the paper of books printed in the sixteenth century, and found copper and even gold in it. The Imperial Academy of Vienna has been discussing the question of the source of these metals, and the most general opinion appears to be that the rags from which the paper was made had, as was common in those days, metallic threads in the weft.

Captain Coste, of the *Sarthe*, has sent home an interesting account of a curious phenomenon he observed about 9 p.m. on the 15th of last September. He was in longitude 50° E., and latitude 9° N., and saw the whole surface of the water white, as though covered with a cloth. On examining some of the water he found that the cause of this appearance was the presence of an innumerable quantity of animacules, which emitted a soft white phosphorescent light. The curious part of the story is, that these animacules only shine while the water is still; when it is agitated the light is extinguished. The same phenomenon has been observed before, but it is very rare. On this subject M. Babinet remarked that it is an error always to refer the phosphorescence of the sea to the presence of infusoria, for the Dead Sea, which is quite destitute of these beings, often becomes phosphorescent.

As I mentioned the petition of the Industrial Society of Mulhouse, asking for a delay in carrying out the decree ordering the consumption of smoke until an effectual means of doing it had been discovered, I may tell you that M. Behic, the Minister of Public Works, has refused to grant the delay, and tells the manufacturers, almost in so many words, to use the best means they can, and perfect their apparatus as fast as possible.

Obviously, in an organ performance, the man who blows the bellows is not an unimportant agent. Some thought of this kind seems to have struck the Mulhouse Society, who, after bestowing medals on the discoverers and manufacturers of aniline and the dyes, have bethought themselves that the part of M. Collas, the distiller of *benzine*, ought not to be overlooked; and although they do not give him a medal, they desire to place on record their belief that he has powerfully, though indirectly, contributed to the development of the industry; and thus the Society adds more celebrity to the name of Benzine Collas.

Some of your readers who will, no doubt, soon be starting for the sea-side may, perhaps, thank me for quoting from *Les Mondes* a *method of preserving star-fish with their natural colours.* Directly they are taken from the water they must be plunged in tolerably strong alcohol for a minute or two, and then dried quickly at a temperature something below 212°. I think I have read this somewhere before; but it may be new to some readers.

Alterations in the Density of Minerals.

To the Editor of the Chemical News.

Sir,—Dr. Phipson, in a letter published in the Chemical News of November 19, 1864, promised to explain why I failed to corroborate his extraordinary statement as to changes in the density of certain minerals. Several months have now elapsed; my papers have been published; but the promised explanation has not, I believe, yet appeared. As I am about to make known the results of a third series of experiments on the subject, I should be glad if Dr. Phipson would furnish the long-expected answer, or, rather, refutation. I am, &c.

A. S. Church.

Royal Agricultural College, Cirencester, June 5.

The Mysterious Death at Dawlish.

To the Editor of the Chemical News.

Sir,—Your recent numbers contain some communications on what has been called the "Mysterious Death at Dawlish," in which it has been stated that arsenic was the cause of death. The coroner has forwarded me the evidence of Dr. Baker, who was called in to the case, and from his evidence I find that on the 10th of April the body was found lying on its back, the head thrown backwards, the arms drawn up towards the head, and the fingers drawn forcibly towards the palms of the hands; after the post-mortem on the 26th he deposed that there was extreme rigidity of the whole body, the spine was completely curved, the head being drawn backwards, forming a concavity, the legs were extended, and the toes drawn to the sole of the foot, the muscles very rigid, the fingers drawn and unyielding, the brain and posterior part of the spinal cord congested, the pupils dilated, the bedclothes, too, were in a greatly rumpled and disordered state. I give Dr. Baker's own words, and his opinion was that the death was occasioned by strychnia, and most undoubtedly it was purely from strychnia, although arsenic was found in the stomach. This suicide is a most singular and interesting case, likely to have an important bearing on future murder cases, and therefore it is worth investigating. The woman had locked herself in the bedroom, and when entrance was effected through the window there was found on the floor three empty papers from rat poison, two of them had contained arsenic, and one of Battle's, which is very well known to be charged with strychnia.

I have seen perhaps twenty animals and reptiles killed with this poison, and found that whenever it was given in the powdered or crystalline state the tetanus commenced in fifteen minutes, and after a few horrible spasms the creatures died (say four or five minutes); if the poison was in a dissolved state the spasms were rarely two minutes in arriving, so rapid was the absorption. Now if Mrs. Williams had mixed the three powders at once in the spoon found, and had drank the warm brandy and water to wash it down, wiping her lips with the handkerchief, all that followed would be accounted for—the strychnia would be in a more soluble state, would act very promptly, and destroy life before the more sluggish arsenic would irritate the stomach to vomiting and diarrhœa; that the death was extremely sudden is proved by this—there was an almond found between her teeth not masticated or even bitten.

This is the only case I know in which two poisons have been in the system at one time, but I think it likely that such will occur in future from the facility found of obtaining the so-called vermin powder.

I am, &c. William Herapath, Sen.,
Professor of Chemistry and Toxicology.

Galibert's Respirator.

To the Editor of the Chemical News.

Sir,—The invention described as Galibert's Respirator in the Chemical News of May 26, 1865, is so much like an apparatus invented by my father (illustrated and described by him in the *Mechanic and Chemist*, November 23rd, 1839), that nearly every reader will see that there is the same train of thought and reasoning for attaining the same end. Quite unbiassedly, I think my father's invention would obtain the preference, for he suggested that the air-bag should be filled with a mixture of one-thirtieth more oxygen than ordinary air.

The copper bag carried on the back is described by him as containing condensed air, which issues gradually and regularly into the hood. With this apparatus a diver, carrying weights round the waist, which he could release when he wanted to come up, would be enabled to explore for a quarter of an hour together the bottoms of canals, lakes, rivers, &c.

In thus writing I do so to claim for my father a priority of twenty-six years in this idea.

I am, &c. Ch. Piesse.

Royal College of Chemistry, May 31.

MISCELLANEOUS.

Chemical Society.—The next meeting of this Society will take place on Thursday next, at eight o'clock, when a paper, "On the Transformation of the Lactic into the Acrylic Series of Acids," will be read by Messrs. Frankland and Duppa.

New Mode of Determining the Strength of Photographic Baths.—Vogel recommends the use of a standard solution of iodide of potassium, which is to be added to the silver solution mixed with a little nitric and nitrous acids, and a few drops of solution of starch. The iodide is added until the blue colour is persistent after agitation.

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

S. H.—Professor Smythe has not yet returned from Egypt.

C. F., St. John's.—Shall receive a private communication.

M. P. S.—We observed it. If our memory serves us, the same thing has been done before; but it is too contemptible to notice.

Dr. Phipson.—Received too late for insertion this week.

Books Received.—The "Dictionary of Chemistry," &c., by Henry Watts, B.A., Part xxxvii.; The "Phenomena of Radiation," &c., by G. Warington, F.C.S.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

An Introduction to Chemical Philosophy, according to the Modern Theories, by ADOLPHE WURTZ, *F.R.S.*

PART I.

EQUIVALENTS, ATOMIC WEIGHTS AND MOLECULAR WEIGHTS.

SECTION II.—*New System of Atomic Weights.*

(*Continued from page 266.*)

According to Deville, sal ammoniac exists in the state of combination at 350°, because its elements if brought together at that temperature disengage heat. The argument may be put as follows:—

Is the disengagement of heat which is observed upon the mixture of two bodies always the effect and the proof of a change in the chemical constitution of their molecules, or of an addition or an exchange of atoms? These are important questions, the solution of which appears to have been given by the beautiful researches of M. Favre on the thermic effects of mixtures.* Having added water to very weak sulphuric acid, M. Favre still observed a disengagement of heat. Thus the addition of four equivalents of water to sulphuric acid already diluted with fifty-six equivalents of water, still occasioned a slight increase in temperature. Who will be bold enough to affirm that the thermic effect is here due to a chemical combination giving birth to a new molecule? Can the molecule $SO_3 60HO$ exist? If it can exist, can it assume the gaseous form? I believe not, and M. Favre considers justly that it is not affinity properly so called which comes into play in actions of the kind which he has observed. He has pointed out others which are similar. The addition of small quantities of water to concentrated solutions of certain salts, possessing their water of crystallisation, can give rise to a disengagement of heat; but if large quantities of water are added, a contrary effect takes place. The phenomenon of the diffusion of the salt in water occasions a diminution of heat.

But in the first place, the disengagement of heat is due, according to M. Favre, to a molecular attraction different from affinity. And why may not actions of this sort be observed in mixtures of gases? Why should not the molecules of hydrochloric acid and of ammonia, although they cannot combine at 350°—that is to say, unite and condense themselves into a true gaseous molecule—why should they not exercise a mutual action at this temperature? And why should not such an action give rise to a disengagement of heat, although it acts at a distance, not between the atoms in a single molecule, but between two different molecules? I am aware that we are dealing here with gases, and not with liquids. But it seems that the molecular constitution of gases does not exclude the idea of a reciprocal attraction able to exert itself at a distance between the atoms of two different molecules.

It may be imagined, on the other hand, that by the fact of their mixture, and by the effect of this attraction, which is perhaps only a degree of affinity, the molecules of the two gases might acquire a stability which they would not possess when isolated. Here would be an explanation of that interesting fact observed by M. H. Deville, that the hydrocyanate of ammonia, or the mixture of hydrocyanic and ammoniacal gases, remains intact at temperatures in which these bodies are themselves decomposed.

It is far from my wish to pretend to have answered the questions I have just put. But is it not allowable to believe that the known facts authorise an interpretation different from that at which MM. Deville and Troost have arrived?

But let us admit for a moment that these questions may be answered in such a way as to oppose the generality of Ampère's law; let us admit that the molecular formulæ of certain bodies, formed, like sal ammoniac, by the union of two molecules, each of which forms 2 volumes of vapour, correspond to 4 volumes of vapour; or rather (for we can make this concession) let us admit that the molecules of such bodies would not take a gaseous form without their vapour expanding, thus forming two molecules which occupy 4 volumes, but which nevertheless remain united by a mutual attraction; these facts would not in any manner weaken the arguments which vapour densities have afforded us in favour of the new system of atomic weights. In fact, if it is possible that the molecule of certain complex bodies cannot take the gaseous form without forming 4 volumes of vapour, the known facts do not authorise us to admit that molecules of compound bodies can exist, which, in the gaseous state, would form less than 2 volumes of vapour;† and it would always be true to say that, for the immense majority of volatile compound bodies, the atomic weights are expressed by their double densities compared to hydrogen, as we have before shown.

We must now sum up this long explanation. After having investigated the origin of the doctrine of equivalents and of the atomic theory, we have followed their progress; we have shown that the notions of equivalent, atom, molecule, at first confounded with each other, have at length acquired distinct meanings; lastly we have demonstrated that of all the systems of atomic weights, that which we are seeking to establish agrees better with the data that are furnished by specific heat and isomorphism, and with the laws which govern the combinations of gaseous bodies.

But our task is not finished. Whatever may be the importance of these physical data in the subject under discussion, such an assistance would be unavailing if it were not strengthened by arguments drawn from the domain of pure chemistry. In a word, the new system of atomic weights must rely upon chemical proof. It is particularly necessary to know whether the double atomic weights, which we have adopted for most of the metals, harmonise with their chemical properties, and with the constitution of their combinations. We think that it is so, and we shall give, in the course of these pages, numerous arguments in support of this opinion.

For the present, we shall confine ourselves to remarking, in conclusion, that the new notation gives, for a very large number of bodies, formulæ identical with those which Berzelius‡ used for twenty years.

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* *Mémoires de la Société d'émulation de la Provence*, I., 117.

† Arsenious acid is alone an exception to this. Its vapour is twice too much condensed, like that of arsenic itself. The two anomalies are evidently connected together. Neither heat nor oxygen succeed in dividing the group of 4 atoms, As_4 (page 158), which forms 2 volumes of free arsenic, and which enters into 2 volumes of arsenious acid, As_4O_6.

‡ Vide Cannizzaro "Sunto di un corso di filosofia chimica," page 8.

We will give some examples of them:—

	Formulæ of Berzelius.	New Formulæ.
Oxide of calcium	CaO	$= \mathrm{\bar{C}a\bar{O}}$
Chloride of calcium	$\mathrm{CaCl_2}$	$= \mathrm{\bar{C}aCl_2}$
Bromide of calcium	$\mathrm{CaBr_2}$	$= \mathrm{\bar{C}aBr_2}$
Iodide of calcium	$\mathrm{CaI_2}$	$= \mathrm{\bar{C}aI_2}$
Fluorine of calcium	$\mathrm{CaFl_2}$	$= \mathrm{\bar{C}aFl_2}$
Nitrate of lime	$\mathrm{N_2O_5,CaO}$	$= \mathrm{N_2\bar{C}a\bar{O}_6}$
Hypochlorite of lime	$\mathrm{Cl_2O,CaO}$	$= \mathrm{Cl_2\bar{C}a\bar{O}_2}$
Chlorate of lime	$\mathrm{Cl_2O_5,CaO}$	$= \mathrm{Cl_2\bar{C}a\bar{O}_6}$
Sulphate of lime	$\mathrm{SO_3,CaO}$	$= \mathrm{\bar{S}\bar{C}a\bar{O}_4}$
Sulphite of lime	$\mathrm{SO_2,CaO}$	$= \mathrm{\bar{S}\bar{C}aO_3}$
Carbonate of lime	$\mathrm{CO_2,CaO}$	$= \mathrm{\bar{C}\bar{C}a\bar{C}_3}$
Acetate of lime	$\mathrm{C_4H_6O_3,CaO}$	$= \mathrm{\bar{C}_4H_6\bar{C}a\bar{O}_4}$
Valerate of lime	$\mathrm{C_{10}H_{18}O_3,CaO}$	$= \mathrm{\bar{C}_{10}H_{18}\bar{C}a\bar{O}_4}$
Benzoate of lime	$\mathrm{C_{14}H_{10}O_3,CaO}$	$= \mathrm{\bar{C}_{14}H_{10}\bar{C}a\bar{O}_4}$
Lactate of lime	$\mathrm{C_6H_{10}O_5,CaO}$	$= \mathrm{\bar{C}_6H_{10}\bar{C}a\bar{O}_6}$
Oxalate of lime	$\mathrm{C_2O_3,CaO}$	$= \mathrm{\bar{C}_2\bar{C}a\bar{O}_4}$
Tartrate of lime §	$\mathrm{C_4H_4O_5,CaO}$	$= \mathrm{\bar{C}_4H_4\bar{C}a\bar{O}_6}$

It is evident that we shall observe the same coincidence in the formula of the numerous compounds that correspond to the preceding, and which contain, instead of calcium, other diatomic metals. Concerning other compounds we will also quote the following formulæ:—

	Formulæ of Berzelius.	New Formulæ.
Water	$\mathrm{H_2O}$	$= \mathrm{H_2\bar{O}}$
Peroxide of hydrogen	$\mathrm{H_2O_2}$	$= \mathrm{H_2\bar{O}_2}$
Sulphuretted hydrogen	$\mathrm{H_2S}$	$= \mathrm{H_2\bar{S}}$
Bisulphide of hydrogen	$\mathrm{H_2S_2}$	$= \mathrm{H_2\bar{S}_2}$
Sulphurous acid	$\mathrm{SO_2}$	$= \mathrm{\bar{S}\bar{O}_2}$
Anhydrous sulphuric acid	$\mathrm{SO_3}$	$= \mathrm{\bar{S}\bar{O}_3}$
Hydrated sulphuric acid	$\mathrm{SO_3,H_2O}$	$= \mathrm{\bar{S}H_2\bar{O}_4}$
Anhydrous nitric acid	$\mathrm{N_2O_5}$	$= \mathrm{N_2\bar{O}_5}$
Nitrous acid	$\mathrm{N_2O_3}$	$= \mathrm{N_2\bar{O}_3}$
Protoxide of nitrogen	$\mathrm{N_2O}$	$= \mathrm{N_2\bar{O}}$
Peroxide of barium	$\mathrm{BaO_2}$	$= \mathrm{\bar{B}a\bar{O}_2}$
,, of manganese	$\mathrm{MnO_2}$	$= \mathrm{Mn\bar{O}_2}$
,, of lead	$\mathrm{PbO_2}$	$= \mathrm{\bar{P}b\bar{O}_2}$
,, of platinum	$\mathrm{PtO_2}$	$= \mathrm{\bar{P}t\bar{O}_2}$
,, of tin, &c.	$\mathrm{SnO_2}$	$= \mathrm{\bar{S}n\bar{O}_2}$
Red oxide of manganese	$\mathrm{Mn_3O_4}$	$= \mathrm{Mn_3\bar{O}_4}$
Minium, &c.	$\mathrm{Pb_3O_4}$	$= \mathrm{\bar{P}b_3\bar{O}_4}$
Sesquioxide of iron	$\mathrm{Fe_2O_3}$	$= \mathrm{\bar{F}e_2\bar{O}_3}$
Alumina, &c.	$\mathrm{Al_2O_3}$	$= \mathrm{\bar{A}l_2O_3}$
Platinous chloride	$\mathrm{PtCl_2}$	$= \mathrm{\bar{P}tCl_2}$
Platinic chloride	$\mathrm{PtCl_4}$	$= \mathrm{\bar{P}tCl_4}$
Stannous chloride	$\mathrm{SnCl_2}$	$= \mathrm{\bar{S}nCl_2}$
Stannic chloride	$\mathrm{SnCl_4}$	$= \mathrm{\bar{S}nCl_4}$
Ferric chloride	$\mathrm{Fe_2Cl_6}$	$= \mathrm{\bar{F}e_2Cl_6}$
Aluminic chloride	$\mathrm{Al_2Cl_6}$	$= \mathrm{\bar{A}l_2Cl_6}$
Sulphate of alumina	$\mathrm{3SO_3,Al_2O_3}$	$= \mathrm{\bar{S}_3\bar{A}l_2\bar{O}_{12}}$
Ferric sulphate, &c.	$\mathrm{3SO_3,Fe_2O_3}$	$= \mathrm{\bar{S}_3\bar{F}e_2\bar{O}_{12}}$

It has been seen that we have barred the letters or symbols which represent elements whose *atoms* are double their equivalents. Berzelius formerly barred the letters which represented the *equivalents* of certain bodies, formed, according to him, of 2 atoms (double atoms). Our barred letters differ, then, from those of Berzelius, inasmuch as they represent atoms which we suppose indivisible. In other respects the bar is a purely conventional sign, but a convenient one, since it enables us to distinguish at the first glance the new notation from the equivalent notation. In adopting it, in this moment of transition, and, it must be said, of confusion, that embarrassment is avoided, which might arise in the mind of the reader by the use of formulæ to which he is not accustomed.

On the Allotropic Condition of Silicium and Carbon in Cast Iron, and their Influence upon the Production of Steel by the Bessemer Process, by Dr. T. L. Phipson, *F.C.S. London, late of the University of Bruxelles, &c.*

The existence of carbon in two allotropic conditions in cast iron—viz., *a* C or combined carbon, and *b* C or graphite, and the influence these conditions exercise upon the quality of the metal and its applications to various purposes in the arts, has been for some time perfectly well known. The element silicium, which is always present in pig irons of every description, has not hitherto attracted attention in this respect. I have recently been fortunate enough, however, to ascertain by a series of analyses of irons of known qualities, that silicium, like carbon, exists in pig irons in two allotropic conditions—viz., *a* Si and *b* Si; and that the predominance of one or other of these forms in a given sample of iron has a very great influence upon the quality of the iron in question, and especially as concerns its capability for being converted into steel by the Bessemer process.

In the present paper I do not wish to enter into practical details resulting immediately from this unlooked-for discovery, but merely to point out as clearly as possible the existence of these two forms of silicium in some of our purest and best qualities of pig iron, as well as in irons of inferior qualities.*

It is yet an undecided question whether the allotropic conditions of elements are generally carried with them into their combinations; the data we possess in this respect with regard to oxygen, sulphur, carbon, silicium, iodine, arsenic, mercury, phosphorus, tin, and some other simple bodies, are still insufficient to determine this important question. Doubtless such is often the case, and doubtless also the circumstances in which the compound is produced suffice already to change the particular allotropic condition of the element. But the fact I have determined, and to which I desire to call attention here is, that on analysing pig irons rich in silicium and carbon, such as are usually obtained in smelting the purest, but always highly siliciferous, red hematites, the former invariably splits up into two portions, *a* Si and *b* Si, and that it is according to the predominance of one of these portions over the other in any particular sort of iron, that this iron can, or cannot, be converted into steel by the Bessemer process.

This fact, of which I have convinced myself most completely, has hitherto escaped notice, and I have reasons to believe that it will sooner or later exercise a very important influence upon the manufacture of iron in general, and especially upon that of iron destined to be converted into steel.

It appears to be a matter of minor importance (phosphorus and sulphur being present in very minute quantities) how much carbon and silicium a pig iron contains in order that this iron may make good steel by the Bessemer process, provided the carbon and silicium be almost entirely in the free state—that is, as *b* C and *b* Si, and that the iron contain little or no *a* C and *a* Si (combined).

Phosphorus and sulphur having been recognised as highly detrimental substances in these irons, ores are sought which contain little or none of these elements; but such ores are precisely those which usually contain the most silica. The red hematites of Lancashire have

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§ With regard to the oxalate and the tartrate, the coincidence of formulæ is accidental, and arises from the circumstance that Berzelius looked upon oxalic and tartaric acids as monobasic.

* I have been much aided in this interesting inquiry by the kindness with which Mr. F. H. Lloyd, the Superintendent of the steel manufacture, at Messrs. Lloyds' and Foster's Iron Works, has forwarded various specimens of irons to me, and given me all the information I could desire concerning them.

given me as an average of a very considerable number of analyses, 10 to 12 per cent. of silica; the red hematites of Germany have also yielded me an average of about 12 per cent.; the amount of silica in the English ores varying between 6 (minimum) and 26 (maximum) per cent. of silica in ores which are smelted at the present day. Now, a large amount of this silica, existing in the ore in the state of quartz, is reduced in the blast-furnace at the same time as the iron oxide, and, like carbon, the silicium produced combines with the metal in two distinct forms.

In analysing a pig iron we find invariably two kinds of carbon in it; the respective quantities of each may vary indefinitely according to circumstances tolerably well known, to which I cannot allude here; but *a* C and *b* C are always to be found. In the pig irons, obtained from red hematites or other ores comparatively free from phosphorus and sulphur, and excellent for the production of steel, it is *b* C which predominates largely. The same rule holds good for silicium: it is only those irons which contain *b* Si in large quantities, or rather, *a* Si in very small quantity, that can be used at all successfully for the production of Bessemer steel. On dissolving pig iron in acid *b* C is deposited in very brilliant scales of graphite, whilst *a* C escapes in combination with hydrogen, as a gas. Something very similar occurs for silicium: provided we use aqua regia as the solvent, which I consider necessary, both to prevent the formation of oxide of silicium, or the escape of any siliciuretted hydrogen, the whole of the silicic acid formed by *a* Si enters into solution, whilst that of *b* Si is deposited.

A quantitative analysis, showing merely the total amounts of silicium and carbon in pig iron free from phosphorus and sulphur, teaches us comparatively nothing with regard to the capability of this iron for being converted in steel, whilst an analysis which shows the amount of *a* C and *b* C, *a* Si and *b* Si, teaches us everything with regard to this question. In illustration of this, let us take the three samples of pig iron A, B, and C, which have yielded me centesimal compositions almost identical, but which are, however, of exceedingly different qualities:

	A	B	C
Total carbon	3·360	2·90	3·12
,, silicium	4·200	3·96	4·23
Phosphorus	0·013	0·01	0·01
Sulphur	0·021	0·05	0·06
Manganese	traces	0·01	traces
Iron	92·400	92·40	92·80
	99·994	99·33	100·22

I say these analyses teach us little or nothing; for why should A make tolerably good steel, B very indifferent steel, and C steel so bad that it cannot be worked at all, which is found to be the case? The reason lies in the relative amounts of *a* Si and *b* Si present, as will be clearly seen in the annexed determination:—

		A	B	C	
Carbon	*a* C	0·30	0·40	0·30	
	b C	3·06	2·50	2·80	
		3·36	2·90	3·12	per cent.
		A	B	C	
Silicium	*a* Si	0·98	1·81	2·60	
	b Si	3·22	2·15	1·63	
		4·20	3·96	4·23	per cent.

It is easy here to see the progressive increase of *a* Si or combined silicium, corresponding precisely with the more and more inferior quality of the iron for steel making. The specimen A must not be taken as the best type of iron for conversion into steel by the Bessemer process; many irons of better composition even than this are used; but it serves well to illustrate the case in point. In a future paper I hope to bring forward some observations on the determination of *a* and *b* silicium and *a* and *b* carbon in pig irons; a subject which requires rather more space than I can give it in the present note.

London, May 5.

*Researches on the Atomic Weight of Thorium, and on the Formula of Thorina,** by M. M. Delafontaine.

Berzelius has attributed to thorium the atomic weight 745, being the mean of three analyses of thoric and thorico-potassic sulphates, in which he obtained 751·3, 741·73, 749·66, and 736·86; this number must be exchanged for 741·3, starting from the received equivalents of sulphur, barium, and potassium.

Berzelius's numbers not agreeing one with another, M. Delafontaine recommenced the study of thorium; he prepared thorina by means of two minerals—the orangite of Aröe and the thorite of Lövön. To obtain pure thorina, we proceed as follows:—We add water and concentrated sulphuric acid to the ore reduced to fine powder, so as to form a semi-fluid paste. The temperature of the mixture rises by itself sufficiently to cause a portion of the sulphuric acid to volatilise; we heat the residue to about 400° or 500° C. so long as it disengages acid vapours; then throw it in small portions into cold water, keeping it constantly stirred; then filter, concentrate the liquid, and heat it in a water-bath; sulphate of thorina, very slightly soluble in boiling water, will be deposited. After having been several times dissolved in cold water, and crystallised from a warm solution, the product may be considered pure, if by calcination it gives a perfectly white earth. The mother liquors, treated by sulphate of potash, give a double salt of thorina and potash. Pure sulphate of thorina is dense, white, and cheesy; it is composed of a multitude of small needles, which felt together. By adding to sulphate of thorina a quantity of water insufficient to dissolve it, it is in the space of one or two days transformed into colourless crystals, about three millimetres long.

To determine the equivalent, we used sulphate dried at 100° C. This salt purified several times by crystallisation with heat, until the portion remaining in solution has the same composition as that which is precipitated. The acid of the sulphate may be expelled by calcination. This salt does not attract moisture from the air; it has been exposed for three weeks without increasing in weight. The sulphate crystallised when cold, decomposes equally well by heat, but it has a great tendency to effloresce. Thorina obtained by calcining the first of these salts is a white, light earth, similar to magnesia; the other, much denser, forms a powder rough to the touch.

In the determinations made by the author, he dried the salts at about 400° or 500° C., and they did not lose their solubility in cold water. The anhydrous residue, heated to a bright red, until the weight remained constant, gave thorina, which served to determine the atomic weight. Three experiments gave the following numbers:—824·7, 823·1, 822·3, the mean of which is 823·3.

The difference between this mean and the number 841·3, found by Berzelius, is considerable; so to check his experiments the author made some further determi-

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* *Archives des Sciences Physiques et Naturelles*, xviii., 343. Abstract from *Bulletin Mensuel de la Société Chimique de Paris*, April, 1865, p. 278.

nations. After dissolving the salt in water he added oxalate of ammonia to precipitate the oxalate of thorina, which he calcined till completely decomposed; he then determined the quantity of sulphuric acid in the filtered liquid by means of chloride of barium. It was not possible to precipitate the sulphuric acid directly by chloride of barium, the sulphate of baryta then formed taking down with it part of the salt of thorina. The mean of fourteen determinations of thorina in the dried salt at 100° C. gave 52·51 per cent. of thorina; the mean of three estimations of sulphuric acid gave 31·92, and the equivalent of thorina, calculated according to these numbers, is 822·5, which agrees with the number above indicated. By subtracting the same two means from 100, there remains for the water 15·57.

Sulphate of thorina deposited in a boiling solution has, according to Berzelius, the composition—

$$ThO.SO_3 + 2HO,$$

and that which crystallises in a cold solution—

$$ThO,SO_3 + 5HO.$$

According to his own analyses, the author gives, for the first, $4(ThO,SO_3) + 9HO$, and for the second $ThO,SO_3 + 9HO$. It has never been shown that thorina was a base of the form RO; Berzelius supposed it possible, because in the thorico-potassic sulphate the sulphuric acid is divided between the two bases, but it would be so still were this salt represented by $ThO_2.2SO_3 + 2(K_2O,SO_3)$, instead of $ThO,SO_3 + K_2O,SO_3$.

MM. Mordenskiöld and Chydenius[†] have stated that thorina crystallises by the dry way in the same form as stannic and titanic acids. It would not then be impossible that the formula of thorina, as well as that of zircon, which so much resembles thorina, should contain one atom of metal and two of oxygen. If such be the case, simpler formula correspond to the analyses; they become, by making the atomic weight of thorina = 1646·6.

$$2(ThO_2,2SO_3) + 9HO \text{ and } ThO_2,2SO_3 + 9HO.$$

The quantity of water in the first salt is, indeed, fractional, but there are other examples of this fact, for the sulphates of uranium, cadmium, yttrium and didymium contain on $\frac{8}{3}$ and the others $\frac{9}{2}$ equivalents of water. However that may be, the author proposes 1646·6 or 263·5 (o = 16) for the equivalent of thorina, and 1446·6 or 231·5 (o = 16) for that of thorium.

The author, who finished his memoir at the same time that M. Chydenius[‡] published his researches on the salts of thorina, differs from him on several points. According to M. Chydenius, sulphate of thorina contains an atom and a-half, sometimes even a single atom of water, and loses it altogether at a temperature of about 235° Centigrade. M. Delafontaine has never observed any variation in the proportion of water in a sulphate.

Five series of experiments, with a maximum of 861 and a minimum of 814, have led M. Chydenius to the mean 840·5 for the equivalent of thorina. The salts which have served to establish these numbers are the acetate, formiate, oxalate, and sulphate of thorina and thorico-potassic sulphate. As to the first two salts, thorina is so feeble a base, and formic and acetic acids are so volatile, that there is always a probability of losing a small quantity of these acids by drying at 100° Centigrade. Moreover, the acetate is insoluble and the formiate decomposes even in cold water; they can then hardly be purified by repeated crystallisations.

The oxalate leaves by calcination 59·40 per cent. of base, the mean of six operations, from which is deduced 823·1 as the equivalent of thorina. This number is close to that of M. Delafontaine, but it differs widely from 841·8, deduced from Berzelius's analyses of sulphate. The difference is probably attributable to the process of analysis employed for the latter salt.[§]

Though M. Chydenius has established the isomorphism of thorina with oxides with two atoms of oxygen, he nevertheless preserves the formula ThO proposed by Berzelius. The analysis of different fluothorates lends fresh support to M. Delafontaine's opinion; for, by doubling the equivalent of thorium the formulas of these compounds become analogous to those of the fluozirconates described by M. Marignac.

M. Delafontaine's first experiments were founded entirely on those of Berzelius; sulphate of thorina precipitated by caustic potash deposits the base, the weight of which, compared with that of sulphuric acid, obtained by treating the filtered liquid by chloride of barium gives the required atomic weight. However carefully it may be washed, the proportion of thorina varies between 53 and 55 per cent.; hence the author gives the preference to the results furnished by the calcination of sulphate. Thoric hydrate is gelatinous, but instead of remaining long in suspension in the water it easily falls to the bottom of the vessel. When thrown on the filter it quickly cracks, often even before losing all the water. The washing is thus made much more uncertain.

Researches on Black Phosphorus,[‖] *by M. le Dr.* BLONDLOT.

THE colour of crystallisable phosphorus presents three varieties—it may be white, yellow, or black. The last variety discovered by Thenard can only be reproduced accidentally, and indeed its existence has been doubted by most chemists.

Endeavouring to find out the secret of this preparation, I found that agreeably to Thenard's opinion the colour of phosphorus owes its degree to the way in which it is cooled after having been melted.

Phosphorus is, as we know, purified by distillation. I perform this operation in a current of hydrogen by means of a small tubular retort, heated in a sand bath, and adapted to a flask half full of water, resting at the bottom of a large vessel filled with water at 70°. On dismounting the apparatus there is usually found a certain quantity of red phosphorus at the bottom of the retort. Now from what I have observed it is in the production, and in the successive elimination of the latter that the conversion of ordinary yellow into white and reputed pure phosphorus consists. I also found that to insure success in bleaching phosphorus by repeated distillations, it is necessary between each operation to submit it to insolation in glass tubes, so as to convert the yellow part which is volatile into red phosphorus, which is fixed. When bleached in this way phosphorus has a strong tendency to turn suddenly black. Rapid cooling may produce this effect, as Thenard has shown; he obtained this result by melting his phosphorus in fine tubes, which he then plunged into cold water. Melted again, the black phosphorus thus produced lost its colour, and did not regain it till it had been rapidly cooled. Hence it has been inferred that black phosphorus is the result of a kind of tempering. This is an error, for I have obtained it more easily in quite a con-

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[†] *Poggendorff's Annalen der Physik und Chemie*, cx., 642, and *Repertoire de Chimie Pure*, 1862, p. 112.

[‡] See *Bulletin de la Société Chimique*, i., 130.

[§] See *Repertoire de Chimie pure*, 1861, p. 39, and *Annales de Chimie et de Physique*, lx., 12.

[‖] *Comptes Rendus*, lx., 830.

trary way—that is to say, by very gradual cooling. In this way I habitually procure black phosphorus. For this purpose I distil phosphorus, previously insolated, until the product collected in the balloon very slowly cooled in the water-bath suddenly turns black. This curious change generally takes place in the following manner:—When the temperature has fallen to about 44°, the phosphorus solidifies in the usual way into a white mass; then, when after several hours the water is only at 5° or 6°, the phosphorus suddenly—in the space of a second—turns to a beautiful black. Black phosphorus, when once obtained, may be re-melted and re-distilled without fear. When liquid it is colourless, but returns to black by very slow cooling. It presents, moreover, all the characteristic properties of ordinary phosphorus, except that it is softer.

It follows from the above researches that as yellow phosphorus is recognised as impure, and as the white is but a transitory state before arriving at the black, the latter, much more stable, should be considered not as an anomaly, but, on the contrary, as the true type. A support for this opinion is to be found in the fact that phosphorus which has been long exposed to diffused light, and has become covered with a layer of red, is found to be black inside, as though, in becoming spontaneously purified, it had undergone a molecular change somewhat analogous to crystallisation.

On Combinations of Boron with Chlorine and Bromine,* *by M. J.* Nicklès.

Anhydrous boracic acid, dissolved in absolute alcohol and treated by a current of hydrochloric or dry hydrobromic acid, exchanges its oxygen for chlorine or bromine, so that chloride or bromide of boron is formed, which remains in combination with the organic molecule.

Chloride of Boron, $BoCl_3$.—As Ebelmen has shown, anhydrous boracic acid is soluble in absolute alcohol. Such a solution quickly absorbs the hydrochloric gas, and becomes oily. It fumes in the air; water decomposes it, producing boracic and hydrochloric acids and alcohol. It is not volatile, though it emits vapours containing a little chloride of boron.

Though this liquid seems to be merely an alcoholic solution of boracic acid saturated with hydrochloric gas, its composition is very constant, and is exactly represented by the formula—

$$(1)\ 3BoO_3.3ClH + 5(C_4H_5O_2).$$

In fact—

	Calculated.	Found.
Cl_3	24·42	24·41
C_{20}	27·52	27·65
H_{28}	7·56	7·72

Heated, it emits volumes of boraciferous hydrochloric gas; the thermometer rises rapidly, and stops at 85°. The residue is boracic acid.

The volatile part is hydrated chloroboracic ether having the formula—

$$(2)\ BoCl_3 + 5(C_4H_5O) + 9HO,$$

deduced from the following results:—

	Calculated.	Found.
Cl_3	27·91	27·88
C_{20}	30·23	30·92
H_{34}	8·8	8·60

This, it will be seen, closely resembles the elementary composition of (1), the boracic acid being deducted.

With the same acid, anhydrous ether, and dry hydrochloric gas, analogous results are obtained, always with the condition of heating for some time at 100° in a closed vessel.

Bromide of Boron, $BoBr_3$.—Hydrobromic acid gives nearly the same results as hydrochloric acid. On distilling the alcoholic liquid obtained by saturating boracic acid with hydrobromic acid, the thermometer stops at 92° C. The product of the distillation is composed of two superposed liquids, which, rectified separately, are reduced to one and the same ether, the boiling point of which rises gradually, but does not pass 135°. The residue is composed of a little boracic acid.

The liquid collected at 115° may be represented by—

$$(3)\ BoBr_3 + 13(C_4H_5O_2) + 3HO;$$

or, rather, by

$$(4)\ BoBr_3 + 13(C_4H_5O) + 16HO.$$

In fact—

	Calculation.	Found.	
Br_3	27·39	27·36	
C_{52}	35·61	35·70	35·84
H_{81}	9·24	9·50	

All these ethers resemble each other in their corrosive taste, the white fumes they emit and which coats the surrounding bodies with boracic acid, and finally in the property of turning brown certain vegetable yellows, such as turmeric. The vapours produce the same effect; however, this reaction takes place only when the coloured paper is dry, for the tint is not developed in presence of water, the boron having turned to boracic acid.

The presence, in definite proportions, of boron, bromine, and chlorine, prevents my seeing in them the boric ethers obtained by MM. Ebelmen and Bouquet, with alcohol and chloride of boron.† These may be produced by distilling the new ethers with some alcohol, which will effect the transformation of the chloride or bromide of boron into boracic acid. The necessity of preparing chloride of boron is thus avoided, an operation so difficult and costly that some other means of preparing boracic ether has long been desired.

The new compounds (2) and (4) behave with peroxides in the same way as ether charged with hydrochloric acid —that is to say, they transform them into perchlorides and perbromides. Sesquioxides are acted on in the same way.

THE
DUBLIN INTERNATIONAL EXHIBITION.

By Chas. R. C. Tichborne, *F.C.S., F.R.G.S.I., &c.*

(*Specially Reported for the* Chemical News.)

On Tuesday, May 9, 1865, the Dublin International Exhibition was opened with all the pomp and grandeur attendant upon such events. The Heir Apparent to the Throne—amongst a host of coronets, military plumes, judges' wigs, mayors' gowns—inaugurated the magnificent building yclep't the Winter Gardens, by declaring the Exhibition opened. Neither was science or literature unrepresented upon that occasion. The following well-known names were noticed:—The Lord Chancellor, Lord Rosse, Sir Edward Landseer, Sir David Brewster, Dr. Lyon Playfair. Sir Robert Kane, Professor Bentley, A. Brady, A. Claudet, Owen Jones, Thomas Fairbairn, T. M. Fairholt, J. H. Foley, Captain Fowke, S. C. Hall, R. Thompson, H. Way, Digby Wyatt, P. Le Neve Foster,

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* *Comptes Rendus*, lx., 800. 65.

† "Recueil des Navans Scientifiques," de M. Ebelmen, t. 1, 205. Paris: Mallet-Bachelier.

Parry (*Illustrated London News*), President of the Royal College of Physicians, President of the Royal College of Surgeons, Professor T. Archer, B. Guinness, Professor Sullivan, Sir R. Griffith, Sir B. Burke, &c., &c. Indeed, it was what in national parlance would be called "a great day for Ireland."

The origin and history of the Dublin Exhibition may be told in a few words. The idea of a winter garden emanated from Mr. H. Parkinson, the present secretary, and was warmly taken up by Mr. Guinness and other members of the committee. A company was formed for the purpose of providing an exhibition palace after the model of the Crystal Palace at Sydenham, but on a scale suitable to the population of the city. A tract of about seventeen acres in extent, formerly known as the "Coburg Gardens" lying within a few minutes' walk from the busiest centre of the city, having passed into the possession of Mr. Benjamin Lee Guinness, that gentleman, with his characteristic liberality in the promotion of all that can add to the comfort and happiness of his fellow citizens, placed the land at the disposal of the newly formed company at the price for which he had purchased it.

The first stone of the building was laid in March, 1863, by the late Earl of Carlisle. As the buildings advanced their suitability for the purpose soon suggested the idea of inaugurating the new institution by holding an international exhibition, nothing of that kind on a large scale having been attempted in Ireland since the exhibition of 1853, known as the Dargan Exhibition, and which was opened by her Majesty.

To accomplish this enterprise a new organisation was resolved on, and the Company leased their premises at a fixed rent for the period of the Exhibition to the present executive committee.

The precedents of former exhibitions, and especially that of 1862, have been followed as far as circumstances admitted.

The objects for exhibition have been divided into six great classes, five containing the industrial products, and the sixth comprehending every branch of the arts—*i.e.*, Raw materials, textile fabrics, metallic, vitreous and ceramic manufactures, miscellaneous manufactures, and fine arts. Under the first denomination are included mining and quarrying processes and mineral products, chemical substances and articles of food. Under the second we find not only machinery in motion and at rest, but philosophical and musical instruments and implements of modern warfare. The third department is occupied by fabrics of cotton, wool, silk, lace, and leather. The fourth by products of the smith and potter. Under the head of miscellaneous come articles required for decoration. Photography is included in the fine arts, and many specimens of delicate workmanship usually classed as jewellery belong to the same denomination. But in an international exhibition additional complication arises from the fact that the division of products into these six classes is co-ordinate with their division into national departments.

The space has been mapped out in accordance with the following plan:—France has been assigned the circular "apse" and its galleries. Prussia and Austria have the western side and galleries of the southern transept. Belgium and Holland and Germany the eastern side. The French stands occupy, in addition to the apse, a large extent of the northern transept and its galleries, and opposite to them is the space allotted for Italy, Rome, and Switzerland. Denmark, Norway, and Sweden have the corners of the northern transept, but the whole of the great glass hall which stretches from this along the side of the main building is devoted to home and colonial manufactures. A Committee of Advice, composed of gentlemen selected for their special knowledge, took charge of each class. In London the Society of Arts gave their timely and cordial support.

Her Majesty has sent many valuable contributions from the Royal collections, and has officially introduced the Exhibition to the authorities of the British colonies and foreign Governments. Most of these Governments have deputed special representatives to attend and to oversee the interests of the exhibitors from their respective countries, and to aid in the selection of the jurors who will early in June adjudicate upon the merits of the productions.

Like all Irish exhibitions, it is more of an art exhibition than one of raw materials and machinery. The fine arts proper—viz., sculpture, painting, and photography, are well represented, and decorative art as applied to textile fabrics, metallic and pottery manufactures, are there in abundance; but there is a falling off from the exhibitions of Great Britain as regards the raw materials, therefore the chemical reporter has not the work before him which he had premeditated before the memorable 9th of May when the gate "op'd his ponderous and marble jaws" to the curious and expectant crowd; but there is still enough to interest and instruct even in our own strict department. Many new phases have cropped out through the instrumentality of our own splendid science since the Exhibition of 1862. Although only two or three years have elapsed, science has been going at an electric pace, and the accessories must keep up with the rush. In the words of the author of that masterpiece of reports,* "Progress, rapid and important, in all branches of art and manufactures—such, broadly and briefly stated, is the gratifying result elicited by a general comparison. Everywhere his eye will be met by proofs of the all-pervading influence of chemistry in the development of the arts; everywhere he will see new materials, elementary or compound, placed by chemistry at the artificer's disposal; finer and more delicate results of all kinds achieved by aid of the knowledge due to chemical investigation."

Precious Metals, &c., British Department.—Perhaps one of the most interesting cases in the Exhibition is Messrs. Johnson, Matthey, and Company's case of precious metals. For although it may contain nothing of absolute novelty, the very rare and beautiful specimens must elicit a certain amount of admiration even from those who are not acquainted with the difficulty which is experienced in procuring such substances as are here exhibited. The principal things in this case are platinum boilers, alembics, syphons, tubing, and capsules, &c., which are soldered by what Messrs. Johnson and Co. call the patent autogenous process—this euphonious name expresses, as we suppose, the fusing of the platinum seams together, by which the use of gold is avoided. A boiler for the rectification of sulphuric acid is exhibited, valued at 1500*l.*, and capable of rectifying to the full strength three tons of sulphuric acid per day. The firm makes boilers with all the recent improvements capable of concentrating from half a ton to ten tons of acid per day.

Apropos of platinum sulphuric acid stills, there can be no doubt that the large manufacturers of sulphuric acid are reverting back to the old plan of concentrating

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* Report upon the Exhibition of 1862, Section A, Chemical Products and Processes.

in glass. The great wear and tear produced upon the platinum by the sulphuric acid (especially when containing nitrogenous products), combined with the interest of capital sunk, have induced the manufacturers to return to their old love. Dr. Hofmann, in his Exhibition Report, refers to this fact, but mentions at the same time that the platinum seems still to hold its ground in France. The writer of the present report paid a visit last winter to one of the largest sulphuric acid manufacturers in England, and found that he had completely discarded the platinum. The great disadvantage occurring from the frequent breakage of the glass has been in a great measure overcome by the judicious choice of glass suited to the purpose, a careful tempering of the alembics after they are made, and the exclusion of the exposed parts of the vessels, when working, from currents of cold air. The alembics are generally placed in rows on each side of a long chamber, and the number of fires naturally conduce towards an atmosphere the temperature of which is a guarantee against unequal expansion, providing nothing comes in actual contact with the glass. The retorts are worked continuously, being filled with hot acid.

M. Scheurer-Kestner says that in an apparatus producing 4000 kilogrammes 1000 kilogrammes were found to dissolve, and to carry off two grammes of platinum; when the sulphuric acid contains nitrous vapours, this quantity was increased to four or five grammes. But according to M. Kestner the alloy of platinum and iridium is comparatively unacted upon by boiling sulphuric acid.†

Messrs. J. and M. show a specimen of this alloy, but we are not aware that any practical attempts have been made towards its use in the construction of sulphuric acid stills. An alloy of this metal and osmium is also shown, which is used for pen points.

There are exhibited also in this case some specimens of platinum gauze, which, we may suggest, might find some uses in connection with chemical gas burners, and would be also applicable to laying under the combustion tube in an organic analysis.

The same firm likewise exhibit copper vessels plated with platinum, which are worthy of a more extended application for chemical purposes.

A model of the ingot of pure platinum is shown, "melted by the intense heat of combined gases." Weight, 3200 ounces; value, 3840*l.* Palladium and some of its salts are here exhibited. We may mention that this metal seems to have now become extremely rare, probably from the fact that the native platinum now worked in this country does not contain much palladium. Splendid crystals of chloroplatinate of sodium are exhibited; some of them more than an inch in length.

Bismuth is represented by a fine iridescent specimen composed of distinct crystals.

The specimens of trichloride of gold exhibited by this firm are very fine, and are worthy of a special notice. The salt as exhibited by Messrs. Johnson and Matthey is of a bright orange colour, and in distinct needles, perfectly dry. The mode in which this appearance is procured is by one of those simple trade manipulations which, although not mentioned in books, are often of the utmost importance as regards the appearance of the manufactured article. From the ready solubility of trichloride and its deliquescent nature, it is necessary to evaporate the solution until it will set into a dark-red and crystalline mass on cooling. But by allowing the solution to cool slowly to a point somewhat short of its actual solidification, and then pouring off from the crystals already formed the still fluid portion, a mass is procured of the most brilliant colours, and consisting of a network of distinct prisms. The product procured in this manner is less hygroscopic than the ordinary salt.

The specimens of nitrate of silver and lunar caustic are excellent, and we have samples of what is called triple crystallised nitrate for photographic purposes. The product is certainly very pure and neutral; so exactly neutral is it, that the writer has observed that most of the distilled water, as sold, gives a decided opalescence with this salt — particularly if the water has been distilled some time, and contains in consequence any microscopic vegetation. They also show a platinum pyrometer (patent) described as "a novel application of the spiral coil of a compound laminæ of two metals of unequal expansion by heat."

But perhaps the most interesting in a scientific point of view are a few rare metals and non-metallic elements which are here. These include two magnificent specimens of graphitoidal boron and silicium, the latter forming a very beautiful object. Iridium, rhodium, osmium, ruthenium, tellurium, selenium, cæsium, and rubidium.

Pitch blende, uranium, and its pretty greenish-yellow salts are also exhibited. The patent sunlight, magnesium, is also here in great force, but your readers are so conversant with its properties that it is needless to dwell upon the subject.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 1.

Professor A. W. WILLIAMSON, *Ph.D., F.R.S., Vice-President, in the Chair.*

IN continuation of our report of the proceedings of the ordinary meeting of June 1 (at page 270), we resume the subject of Dr. Miller's discourse upon "*Some Points in the Analysis of Potable Waters.*" After describing the methods for determining the amounts of organic matter and nitric acid, the author referred to the estimation of ammonia. For this purpose a deci-gallon of the water is mixed with about one fluid ounce of baryta water, and distilled until one-fourth part of the contents of the retort have passed over; the liquid remaining in the latter may be conveniently employed for the detection of nitric acid, whilst the distillate is divided into two equal parts, one of which is immediately tested for ammonia by Nessler's solution (*i.e.*, iodide of mercury dissolved in aqueous iodide of potassium, and an excess of caustic potash afterwards added). In the event of ammonia being present in large quantity a precipitate is formed, but in most cases a yellow colouration only is the result; and inasmuch as it is desirable to employ this method of examination as a colour-test, Dr. Miller recommends that the ammoniacal distillate should be further diluted, if necessary, until nothing amounting to a precipitate is produced on addition of the mercurial compound, the reserved half of the liquid being available for this purpose. So delicate is this test that ·003 grain of ammonia is sufficient to show

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* Two capsules—one of platinum and the second of platineridum alloy—were introduced into a platinum alembic, and exposed for two months to the action of boiling sulphuric acid. The capsule of pure platinum was entirely deformed, and its surface corroded. It had lost not less than 19·66 per cent. of its weight. This capsule of iridio-platinum, on the other hand, was found to have retained its form; the surface had remained brilliant, and the loss did not amount to more than 8·88 per cent. of its weight. The loss of the second capsule is accordingly not more than 45 per cent. of the loss of the pure platinum vessel."

a decided yellow colouration, and the depth of tint observed in a quantitative experiment is compared with the result furnished by a highly dilute solution of sal-ammoniac of known strength. Whilst giving the preference to this mode of determining the ammonia, the author stated that larger amounts might be treated at once with standard acid according to the usual process of alkalimetry. The methods of estimating chlorine, sulphuric acid, potassium, and sodium did not call for any special remark; but with regard to calcium Dr. Miller stated that he was accustomed to overcome the difficulties of burning the oxalate by heating in a muffle to a very high temperature, when pure caustic lime remained as the product to be weighed. The lecturer then adverted to the presence of free oxygen in water, and showed a very convenient apparatus for expelling this gas by ebullition, and collecting it over mercury. It consisted of a glass balloon, of one decigallon capacity, in which the water was boiled, surmounted by a delivery tube expanded into a bulb immediately above the neck of the flask, and which served to return a large proportion of the condensed water. The outlet of the delivery tube dipping into the mercury trough was overlaid with caoutchouc, which prevented the violent concussions usually resulting from the sudden condensation of steam. Dr. Miller exhibited his transfer tube, with flexible joints, which might then be conveniently employed in the removal of part or the whole of the oxygen for endiometric analysis; and concluded with some excellent remarks upon the general mode of stating the analytical results and of associating the acid and basic constituents: the results should, he thought, be reported on a decimal system (if the litre itself be not adopted), besides stating for the information of the general public in grains per gallon. He considered it likewise advantageous to show in a supplementary table the proportions of chlorine, calcium, magnesium, &c., actually found, which would facilitate the comparison of independent analyses, and show facts with the least possible garb of theory.

The **Chairman** commented upon the value of the ammonia test proposed by Dr. Miller, and referred to the discrepancies which often occurred in reporting the analyses of water.

Dr. **Frankland** offered a remark to the effect that he should not be satisfied with an analytical statement which did not show the mode of union presumed to exist in the case of the several acids and bases discovered in the water.

Dr. **Miller** here explained that he was urging the desirability of showing two tables—one would indicate the proximate constituents actually discovered and the other the forms of combination presumed to occur. With respect to the mercury test for ammonia, he desired to give Mr. Hadow the credit of having suggested its employment in the manner just now recommended.

Mr. **Dugald Campbell** hesitated in placing reliance upon the use of permanganate of potassium as a reagent for the determination of organic matter in waters. About fourteen years ago Dr. Clark and himself made a series of experiments under the precise conditions which had been described, but without arriving at satisfactory results, for the same water required varying proportions of the permanganate according to the degree of concentration, and would, after keeping some time, decolourise more of the test than when freshly collected. The speaker then referred to the anomalous action of magnesium salts in interfering with the action of the soap test as proposed by Dr. Clark, and said that the alkalinity of a water was a property which should be observed, inasmuch as the deep well waters of London contained carbonate of sodium.

Dr. **Voelcher** mentioned an anomalous result which happened in his personal experience whilst taking the "hardness" of a sample of river water. From some cause which he could not fathom the degree of hardness became increased upon boiling, and the results were the same whether the ebullition were continued for one, two, or three hours.

Dr. **Bachhoffner** said it was very desirable that some uniform standard should be agreed upon for stating the amount of organic matter in waters. It was customary for the late Dr. Thomson to report this impurity in grains per gallon, and to quote the Marylebone pump-water, and the question became one of importance when it was known that there were Officers of Health in every parish interested in the promulgation of exact data as a standard of comparison.

Dr. **Odling** said that although a table showing the elementary constituents would be useful to the chemist as a means of comparing results, it would not satisfy the general public, who preferred the information to which they became habituated. A determined effort in the direction of following Dr. A. W. Hofmann's monthly report in the *Times* would surely lead to the general adoption of a new mode of stating the amount of oxidisable matters present in any given sample of water; but with regard to the permanganate test, it became a matter of importance to know precisely the degree of delicacy. Was it affected by temperature, or by dilution? and, further, had it been ascertained whether equal quantities of the red solution exactly corresponded with equal amounts of organic matter destroyed? In a paper read before the British Association at Bath, Mr. Vernon Harcourt showed that the presence of the manganous salt exerted an influence upon the action of the permanganate, and consequently the first and last portions of organic matter would be destroyed under different conditions. With respect to the property termed "hardness," it would be remembered that Dr. Nicholson, in a paper on "*Water Analysis*" read before the Society, distinctly affirmed that carbonic acid affected the soap-test, and was a cause of hardness. Dr. Parkes found less difficulty in making use of a soft potassa soap, which he standardised with chloride of barium.

Mr. **Vernon Harcourt** made a statement relative to the oxidation of oxalic acid by permanganate of potassium, which he found to be more rapidly accomplished in the presence of a manganese salt, such as the sulphate or chloride. He had made experiments in which the permanganate was employed in great excess for the purpose of ensuring the total destruction of the oxalic acid or other organic compound, and the excess afterwards allowed for by reducing with a known quantity of ferrous sulphate, and again adding permanganate until the colour was persistent; also in other instances the excess of the red solution was got rid of by iodide of potassium and subsequent employment of a standard solution of hyposulphite of sodium.

Dr. **Miller**, by way of reply, said that the permanganate test for organic matter had not succeeded in his hands when he employed that salt in great excess, and afterwards proceeded to determine the amount of surplus; but he found the results very fairly uniform when the experiment was conducted in the cold and in the manner described. Whenever a sample of water contained both organic matter and nitrates, it was impossible to arrive at a decisive result by the incineration of the dry saline residue, and he found likewise that sulphates were reduced to sulphides by the deoxidising action of the carbon compounds. He quite concurred in Dr. Odling's opinion about the mode of reporting the results; and now that it was understood that Dr. Frankland would in future send the periodical reports to the newspapers, he begged him to act upon the suggestion, for he would have the opportunity of "speaking with a very large trumpet." The use of chloride of barium in connection with the soap test should not, he thought, be recommended, since it was possible that it might behave in the indefinite manner evidenced in the case of the chloride of magnesium.

The **Chairman**, in moving a vote of thanks to Dr.

Miller, which was warmly responded to, took occasion to request that he would favour the Society with a written statement of the main facts of his interesting communication for the purpose of being printed in the journal.

The meeting was then adjourned, as already announced.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, March 31.

"*On Scientific Experiments in Balloons.*" By JAMES GLAISHER, Esq., F.R.S., &c.

MR. GLAISHER, at the beginning, referred to the discourse given by him two years since, when he had made eight ascents, for the purpose of scientific researches in the higher regions of the atmosphere, and said since that time he had made seventeen additional. He described the process of filling a large balloon, and briefly described a balloon ascent, speaking of the novel sensation at first experienced, of the extreme coldness and dryness of the air at great elevations, of the painless death awaiting the aërial traveller who should ascend to an elevation too great for his power of endurance, and compared it to that of the mountain traveller, who, benumbed and insensible to suffering, yields to the lethargy of approaching sleep, and reposes to wake no more. Moral energy in both cases, he stated, was the only means of safety.

He then exhibited the several instruments used, pointing out their extreme sensitiveness and delicacy, and then spoke of balloon research.

The subjects of research by means of balloons, he said, were:—

1st. To determine the rate of decrease of temperature with increase of elevation, and to ascertain whether the results obtained by observations on mountain sides—viz., a lowering of temperature of 1° for every increase of elevation of 300 feet—be true or not.

2nd. To determine the distribution of the water, in the invisible shape of vapour, in the air below the clouds, in the clouds, and above them, at different elevations.

3rd. To compare the results, as found by different instruments, together:—

1. The temperature of the dew-point, as found by—
   Dry and wet thermometers—(free).
   Dry and wet thermometers—(aspirated, or air made to pass rapidly).
   Daniell's dew point.
   Regnault's dew point—(blowing).
   Regnault's dew point—(air made to pass rapidly).
2. To compare the readings of—
   Mercurial and aneroid barometers, &c.

4th. Solar radiation, by taking readings of the blackened bulb thermometer fully exposed to the sun, with simultaneous observations of the dry bulb thermometer, and also of observations of Herschel's actinometer.

5th. To determine whether the solar spectrum, when viewed from the earth, and far above it, exhibited any difference; whether there were a greater or less number of dark lines crossing it, particularly when near sun-setting.

6th. To determine whether the horizontal intensity of the earth's magnetism was less or greater with elevation. Propagation of sound. Amount of ozone, &c.

We have only space for some general remarks on the two first heads, and the summary of the observations on solar radiation. On the two last subjects no observations appear to have been made.

The speaker said it is very clear from the particulars of each ascent that they cannot all be combined, or all used in deducing general laws. Those ascents which have been made during the past year under similar circumstances to those from which the laws of decrease of temperature were found, when combined do not change the values previously found to any great amount; but those which have been made under other circumstances, such as in the winter and at times of the setting sun, differ very greatly indeed.

The deviation from this law, however, in winter is certainly of the highest importance to us, the meeting of a strong current of air from the S.W. of so great a depth as nearly one mile, over our country on January 12, in the season of winter, which current I know continued many days, must have exercised great influence. This was the first instance of meeting with a stream of air of higher temperature than on the earth; above this the air was dry, and higher still it was very dry; fine granular snow was falling thickly above this warm stream of air.

The S.W. current being thus observed is of the highest importance as bearing upon the very high mean temperature we experience during the winter—so much higher than is due to our position on the earth's surface; and it is highly probable that to its fluctuations the variations of our winters are due.

Our high winter temperature has hitherto been referred for the most part to the influence of the heated water of the Gulf Stream; but if this were the case the same agency, being at work around the coast of France, should exercise the same influence; yet we know that the winters of France are more severe than our own, though situated so much south of us.

Dr. Stark, of Edinburgh, some years since referred the mildness of the winters in Britain for the most part to prevalence of the S.W. or anti-trade wind, which is the prevailing aërial current in this latitude during winter.

He observes, so long as these winds blow, we have no frosts or intense colds; but the moment the wind changes during winter to an easterly, north-easterly, or northerly direction, we have both frost and snow, and more or less intense cold.

The S.W. winds in their course meet with no obstruction in coming to us, but they blow directly to us and to Norway over the Atlantic; and hence we enjoy a much milder climate during winter than any other lands not similarly situated with regard to such winds.

The south-west winds cannot reach France till they have crossed the whole of Spain and the high mountain range of the Pyrenees; and by the time they have crossed that mountainous country they are so much cooled that France can derive comparatively little benefit from them, and hence apparently her more severe winters.

Another fact may be inferred from this winter trip; it has always been a matter of great difficulty to me to account for the simultaneous appearance of dense fog over the whole country, and extending far out to sea; but the fact of a warm current of air, situated under a mass of snow falling, would fully account for the production of any amount of fog.

Another inference may be drawn from the facts noticed. One only I will mention, and it is this: If during the prevalence of a warm current of air passing over these islands there can be currents of air of so low a temperature as I experienced, it is evident that as it is but a struggle between two or more forces, either of which may preponderate at any moment, it is not safe, therefore, in the winter months, how mild soever the weather may be, to go thinly clothed at any time, for at any moment this warm current may be deflected, and its place occupied by the cold current, and thus some of our sudden and apparently unaccountable changes may be due.

The fact of no change of temperature being met with at the time of sunset on June 13, for 2000 feet from the earth, that a much smaller change took place than usual on June 20, a little before sunset; and that on June 27, after sunset, as well as could be determined, the change to 3000 feet was small, it would seem that the laws which hold good by day do not hold good by night; indeed, it seems probable that at night, for some little distance, the temperature may increase with elevation instead of decreasing. This can only be determined by experiments at night.

Comparing the results of one experiment with another with respect to the moisture in the air, at the same elevation, it is found to be very different at different times; and that on the same day the moisture is very differently distributed, there having been on some of the days of experiments several successive wet and dry strata placed one above the other.

The variation in this climate, its frequent disturbed atmosphere, the smallness of the country, causing great anxiety after passing through clouds and out of sight of the earth, for fear of descending over the sea, when the balloon has no longer power to keep up, rendering each experiment limited in its duration, that perhaps this country is not the best for determining the laws which govern atmospheric changes.

I am glad to learn that similar observations are contemplated being made in France, and I hope that similar observations will be made in other countries, for it is probable that above the large plains of the Continent, where the weather is more uniform, and where an observer can be for hours out of sight of land without anxiety—that the experiments can be more easily made, and probably, too, the general laws made more easily apparent.

Many ascents will, however, be necessary; clouds as large, and clouds far colder than any I have met with, were experienced by Messrs. Bixio and Barral, in their ascents in June and July, 1850, from Paris. These gentlemen made two ascents for scientific purposes, and although from accidents the ascents were of short duration, the results were of high interest. Among them they noticed that they passed through a cloud of icicles, which sustained themselves in the air, as it appeared to them, contrary to the laws of gravity; but upon their horizontal surfaces they saw beneath them, however, an exact image of the sun, formed by the reflection of the luminous rays on the crystals of ice, floating about in a foggy atmosphere; and they noticed the temperature of the cloud to be as low as minus 40°, a far greater degree of cold than I ever experienced.

With such variations as these, as many ascents will be necessary to be made in France as in England, to determine general laws; but each ascent may be made far richer in results than any one in England. In France, the duration of a journey will be limited only by the wishes of the observer, and not as here by the sea, or by one solitary hour's observations—that being the time frequently in which we approach the sea.

It is certain that there are in the higher regions of the earth's atmosphere spaces subjected to great cold, and others to considerable heat; that there exist some clouds of very low temperature; and some, as those passed through on January 12, for a mile in thickness, of comparatively high temperature.

The presence of such, either cold or hot currents, passing over the country, must play an important part in all our meteorological phenomena, and must exert a great influence upon our climate.

When I first undertook to make these experiments, I expected that a few ascents would have given the information sought; the number of experiments I have now made is twenty-five, and so far from exhausting the subject, they have only indicated a much wider field for future operations.

The law of decrease of temperature under ordinary circumstances, both with a clear and cloudy sky, when the sun is above the horizon, in the months of summer, I think is pretty well determined; but from the series of observations made in winter, we cannot say such laws hold good throughout the year: neither can we say that the laws which hold good by day will be true by night; and the general result of these differences must be that the theoretical law of refraction now used must be abandoned, and that every observatory will have to determine its own laws, independently.

From the experiments on solar radiation we may infer that the heat rays from the sun pass through space without loss, and become effective in proportion to the density of the atmosphere or the amount of water present through which they pass, and if so, the proportion of heat received at Mercury, Venus, Jupiter, and Saturn, may be the same as that received at the Earth, if the constituents of their atmospheres be the same as that of the Earth, and greater if the density be greater, so that the effective solar heat at Jupiter and Saturn may be greater than at either the inferior planets Mercury or Venus, notwithstanding their far greater distances from the Sun.

ACADEMY OF SCIENCES.

June 5, 1865.

M. Fizeau presented a memoir "*On the Dilatation of the Diamond, any Crystallised Protoxide of Copper, under the influence of Heat.*" The author finds that these bodies, like water, present a maximum of density at a certain temperature. The diamond, for example, has its maximum at −38·8°, and protoxide of copper at 4°. M. Fizeau has also determined the co-efficients of dilatation in these two bodies. These are the first two solid bodies in which the maximum of density has been satisfactorily determined, although the probability of a variation with temperature has been shown.

Physicists will read with interest a memoir by M. Sarran, "*On the Propagation and Polarisation of Light in Crystals,*" which, however, it is impossible to reproduce here.

M. Fouque sent another letter "*On the Eruption of Mount Etna,*" in which he describes the present condition of the fumeroles, which seem to have changed their character. At present, or rather on the 31st of May, the dry fumeroles could hardly be said to exist, and the acid, or chlorhydro-sulphurous, according to M. Deville, predominated. These evolve ammoniacal and metallic salts. Chloride of ammonium is freely evolved from the alkaline fumeroles, and exhibits the phenomenon of dissociation at a comparatively low temperature, the vapours being strongly alkaline. The ammonia appears to combine with carbonic acid, for the condensed vapours precipitate lime water. Sulphuretted hydrogen is in some instances evolved, and sulphur is deposited from its decomposition. Carbonic acid is but rarely observed.

M. Corenwinder presented a note "*On Flemish Manure and its Employment in Agriculture.*" Flemish manure is really dried excrement, and nothing more need be said about it.

M. Cannizzaro sent a note "*On the Amines of Benzoic Alcohol.*" Just as phenols have been considered bodies analogous to alcohols, it has been thought that aniline, toluidine, &c., were alkaloids analogous to methylamine, &c. The author has prepared the primary benzylamine, $C_7H_7H_2N$, and finds it to be an altogether different body from toluidine. The former is a strongly alkaline body, soluble in water in all proportions, boiling at 182°, and rapidly absorbing carbonic acid, forming with it a crystalline compound. Primary benzylamine is prepared by adding alcoholic ammonia to chloride of benzyl, and leaving them together for some days. After this time crystals of tertiary benzylamine form, and these being separated, the residue is a mixture of hydrochlorate of ammonia and hydrochlorate of primary benzylamine. The alkaloid is obtained free by treating the solution with an excess of potash. It is separated by ether, and after the evaporation of this is rectified over caustic potash.

MM. A. Vee and Leven sent a note entitled, "*Chemical and Physiological Researches on an Alkaloid extracted from the Calabar Bean,*" which, as reported in the *Comptes Rendus*, adds nothing to what they have told us before about *eserine*, except that the name of this alkaloid is derived from *esere*, the native denomination of the bean.

M. Pelikan sent from St. Petersburg a note "*On a New Poison obtained from Inée or Onage*," a plant of the species Echites, Apocynaceæ. It is obtained from the seeds, paralyses the heart, and is used by the natives of Gaboon to poison arrows.

NOTICES OF BOOKS.

Notes for Students in Chemistry: being a Syllabus of Chemistry and Practical Chemistry. Compiled from the Manuals of Miller, Fownes, Berzelius, Gerhardt, Gorup-Besanez, &c. By ALBERT J. BERNAYS, &c., &c. Fourth Edition, revised and corrected. London: Churchill and Sons. 1865.

THESE "Notes" are intended to be such as an intelligent student would write for himself as he listened to a course of lectures, and with which he would refresh his memory when he "crammed" for his examination. That is as much as saying that they contain the substance of what the student has been told in the fewest possible words.

There is a good deal to be said in favour of such a book as this. We have had occasion to look over a good many students' note-books, and are obliged to say that they do not, as a rule, contain what it is most important to remember. It may be urged also that the practice of writing at lecture is altogether objectionable. It withdraws the student's attention from the experiments, and when he does not write short-hand, he probably loses half the lecture in an unsuccessful attempt to write down the other half. Unfortunately, too, the notes when written are often very illegible, and many never take the trouble to decipher them.

We have sometimes thought that the best way of teaching chemistry—at all events, to medical students, who form the bulk of our chemical classes—would be to take some established manual and go straight through it, illustrating and enlarging as might be necessary, but so proceeding that the student could follow the lecturer step by step with his book. The manual would thus become the note-book of the student, and we venture to think that its contents would be well fixed in his memory. Such a course would obviously not satisfy the requirements of all classes, and certainly would not satisfy the ambition of many teachers, but would still, we believe, have its advantages both for student and lecturer.

We shall give our readers the best idea of these "Notes" by making one or two extracts; and the first we select is a paragraph which is supposed to include all the most important facts relating to oxygen:—

"Oxygen O = 8 (Θ = 16); sp. gr. 1·1057; 100 c. i. 34·29 grains. N.B.—The weight of 100 c. c. of a gas by × its sp. gr. by that of 100 c. i. of air = 31·0117 grains. Sp. gr. compared with H, 15·936: 1774 by Priestley. Colourless, inodorous, non-condensible gas. In admixture in air, 20·81 per cent. by volume, and 23 per cent. by weight of dry air. The most magnetic of gases; the diurnal variations of the needle referable to the effects of heat upon it. Soluble in water to the extent of 3 per cent. at 60°. Necessary to combustion, respiration, decay, and germination. *Prep.* From HgO and heat = HgO. From MnO_2. Thus: $3MnO_2$ + heat = $Mn_3O_4 + 2O$. From KO,ClO_5 by heat = $KCl + 6O$. By electrolysis of water O at + pole or platinode. From $MnO_2 + HO,SO_3$ = $MnO,SO_3 + HO + O$. From $KO,2CrO_3 + 4(HO,SO_3)$ = $KO,SO_3 + Cr_2O_3,3SO_3 + 4HO + 3O$. Allotropic conditions: Ozone $\overset{-}{O}$, and antozone $\overset{+}{O}$. Ozone test paper 5 of starch to 1 of KI. Ozonides, MnO_2, CrO_3, MnO_3, Mn_2O_7."

We select the next extract from the organic division:—

"**Isomerism.**—Identity of ultimate composition, with difference of chemical properties. When the eqs. identical, isomerides said to be *metameric*; when this is not the case, the state of condensation supposed to be different, *polymeric*. C_2H_2, C_4H_4, C_6H_6, C_8H_8 are polymeric. Bodies which stand related to each other like the alcohols, or which differ only by a multiple of C_2H_2, are called *homologous*; all such, when treated with the same chemical agents, furnish others, different, yet standing in a fixed relation; *heterologous*. In homologous bodies, *compound radicles* supposed to exist at methyl C_2H_3 in methylic alcohol $(C_2H_3)O,HO$. Compound types of Laurent and Gerhardt. Distinction between atoms and molecules; the atom the smallest particle in a compound, incapable of separate existence; the molecule, the smallest quantity of an element in a separate state, must consist of at least two atoms. As a rule, the molecules of all compound bodies capable of vaporisation furnish equal volumes."

The above extracts show very fairly the plan upon which the work has been executed; and although the deficiencies of such notes must be apparent to every one, yet it must be confessed that they may prove very useful to a student cramming for a *vivâ voce* examination.

Before the author issues another edition, we would recommend him to reconsider the organic part, much of which, we fear, can only confuse a student. Moreover, it is essential that a work of this kind should be as accurate as possible, and a passage like the following, at page 17, should be corrected:—"N.B.—*Reinsch's* test consists in the introduction of clean and pure copper gauze into the suspected arsenical solution in HCl; As is deposited as a grey film." An examiner would probably expect the student to say that the grey film was an arsenide of copper.

Annales de Physique et de Chimie. April, 1865.

THIS number contains a continuation of M. Weil's paper "*On New Processes for Covering Metals with Adherent Coatings of Other Metals*," an abstract of which we have in preparation. The remainder are papers which we have already noticed.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by MR. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

1006. J. Isherwood, Haslingden, Lancashire, "Certain improvements in dyeing or printing upon the fabric known as sail-cloth."—Petition recorded April 8, 1865.

1310. J. Bennett, Market Street, Sheffield, "Improvements in the manufacture of iron and steel." — May 11, 1865.

1324. W. Hewitt, Brewer Street, Pimlico, "An improved composition for preventing incrustation in steam boilers." —May 12, 1865.

1435. J. Gjers, Middlesborough, "Improvements in ovens or kilns for the manufacture of coke."—May 25, 1865.

1453. S. Sequelin, Devonshire Street, Bloomsbury, "Improvements in purifying animal and vegetable oils or fatty matters to be used for lubricating and other purposes."—May 27, 1865.

1467. P. A. Le Comte de Fontaine Moreau, Rue de la Fidélité, Paris, "Certain improvements in the manufacture of lime."—A communication from L. Poulet, Gouesse, France.

1469. P. Young, Manchester, "Improvements in the construction of furnaces."—May 29, 1865.

NOTICES TO PROCEED.

221. G. Haseltine, Southampton Buildings, Chancery Lane, "A new process of manufacturing syrups and sugar from maize and other cereal grains."—A communication from F. W. Goessling, Buffalo, N. Y., U. S. A.—Petition recorded Jan. 26, 1865.

240. C. de Bergue, Strand, "Improvements in furnaces." —Jan. 27, 1865.

CORRESPONDENCE.

Continental Science.

PARIS, June 10.

I CANNOT say that the hypothesis of Prout has found an advocate in the person of M. Kekulé, but some considerations on the laws of chemical proportions which he has published in *Cosmos* as a sort of reply to M. Stas would seem to indicate that M. Kekulé does not accept the refutation of M. Stas as complete. We must wait until we have the whole of M. Kekulé's considerations before we can make out exactly what his ideas on the subject are. All we can see at present is that he puts forward some curious speculations. Thus, he says we may suppose the atoms of primordial matter to be distributed in space according to certain laws of symmetry, and that regular forms of space will circumscribe a certain number of these atoms, and so by employing forms which present a simple relation we may circumscribe a number of atoms which will also present a simple relation. A regular octahedron for example, will include seven atoms, and thus we may see the relation of hydrogen to lithium. Double the axes of the octahedron and we shall circumscribe 25 atoms; the atomic weight of sodium, however, is only 23. This difficulty may be got over by allowing truncations, but this, as M. Kekulé said, opens the way to arbitrary arrangements which will not do in exact science. This paper will deserve further notice when it is completed, and I will say nothing more about it at present.

I see a simple way of engraving intended to replace wood cutting, which I will quote from *Les Mondes*. The inventor starts with a smooth plate of chalk, on which he makes his drawing with gum water or something else that will harden on the chalk. He then sets to work with a hard brush and scrubs out the soft part not drawn on, and so gets his design in relief. He subsequently hardens the plate by putting it in a bath of gelatine and then drying it.

Case of Suspected Slow Poisoning by Zinc and Iron.

To the Editor of the CHEMICAL NEWS.

SIR,—At Malmsbury on May 20th an adjourned inquest was held on the body of Ann Lait, wife of James Lait, horse doctor. Dr. Salter stated in evidence that he had attended Mrs. Lait from April 12th last for uterine hæmorrhage and vomiting; the former rapidly ceased, but the latter continued till two days before her death on May 6th. She complained of burning heat of the stomach, fauces, and gullet, coppery taste in the mouth, great thirst and nausea after eating and drinking, followed by vomiting after from half an hour to an hour. The husband had entirely waited upon and fed her. Dr. Salter continued to attend her till the 23rd, on which day he called, and found her coming down stairs; she vomited in his presence: this he secured in a bottle, and subsequently I received it. He had been struck with her peculiar symptoms, and on calling on the 24th he saw the husband and wife together, and then said to both that he thought it his duty to tell her "that her symptoms were those of poison, not of disease, advised her to leave home, telling her that if she did she would get well, but if she remained at home she would die, and that he should refuse a certificate in case of her death. They neither of them expressed any concern. On the 29th he gave Lait for her three powders containing oxalate of cerium; on the 5th of May he called and heard she was sleeping; on the 7th a message was left at his surgery to say she was dead, and in the evening Lait called, and said "he had called in Dr. Jeston, who had seen her on the Tuesday and Thursday before her death." Dr. Salter and Dr. Jeston had consulted together, and both refused a certificate. An inquest was held, and a post-mortem followed. On receiving the matters I found the stomach considerably inflamed in the cardiac portion, and the surface in a strange blistered state; there was not much inflammation of the intestines. In the vomit I found traces of sulphates of zinc and iron, so I did in the contents of the lower intestines; but in the remains of food in the stomach and duodenum I found only sulphate of iron. These salts, particularly that of zinc, would produce the effects described, but if used as a means of slow poisoning they would, as far as I know, constitute the first case in which they had been resorted to for the purpose.

I am, &c. WILLIAM HERAPATH, SEN.,
Professor of Chemistry and Toxicology.

Bristol Medical School.

Alterations in the Densities of Minerals.

To the Editor of the CHEMICAL NEWS.

SIR,—In reply to a letter by Mr. Church in your journal of 9th inst., allow me to state that since the publication of the letter he refers to I have not been at liberty to do more than glance over his papers. This I am sure Mr. Church will excuse, when he reflects that my laboratory and my time are at the disposal of the public. From what I have seen of them, his experiments appear to me to have been very carefully conducted; but, if I am not mistaken, were made upon isolated crystals, whilst those alluded to in my paper were made upon groups of crystals; for instance, those with the lime garnet of Vesuvius, with lumps about half an inch square, containing many hundred small crystals, and I have more than once noticed these groups to bulge out slightly during the experiment without any trace of fusion occurring.

I am, &c.
T. L. PHIPSON, Ph.D., F.C.S., &c.

4, The Cedars, Putney, London, S.W., June 10.

MISCELLANEOUS.

Pollution of Rivers.—The Queen has been pleased to appoint Robert Rawlinson, Esq., John Thornhill Harrison, Esq., and John Thomas Way, Esq., to be her Majesty's Commissioners for the purpose of inquiring how far the present use of rivers or running waters in England for the purpose of carrying off the sewage of towns and populous places, and the refuse arising from industrial processes and manufactures, can be prevented without risk to the public health or serious injury to such processes and manufactures; and how far such sewage and refuse can be utilised or got rid of otherwise than by discharge into rivers or running waters, or rendered harmless before reaching them; and also for the purpose of inquiring into the effect on the drainage of lands and inhabited places, of obstructions to the natural flow of rivers or streams caused by mills, weirs, locks, and other navigation works, and into the best means of remedying any evils thence arising.

The Dawlish Poison Case.—The jury in this case, and some of the inhabitants of Dawlish, have subscribed to remunerate Dr. Herapath for his analysis and evidence.

ANSWERS TO CORRESPONDENTS.

Dr. Phipson.—The number will be forwarded as directed.

W.—We are sorry to say we know of no substances that will answer the purpose. Consult a good dentist, and have them properly stopped.

X. Y. Z.—The communication has not been received.

Received.—Dr. G. Lunge; Dr. Herapath, F.R.S.

Book Received.—"On Radiation:" the Bede Lecture, delivered in the Senate House before the University of Cambridge, on Tuesday, May 16, 1865, by John Tyndall, F.R.S., &c., &c.

Erratum.—In Dr. Lunge's paper on "The Action of Carbon on Ammonia," p. 266, line 31, *for* "unstable," read "suitable."

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

A Contribution to the Knowledge of Indium, by Dr. C. Winkler.*

Zinc from the Freiburg mines contains, besides a small quantity of lead, a small proportion of iron, arsenic, cadmium, and 0·0448 per cent. of indium. To separate the last the zinc is dissolved in dilute sulphuric or hydrochloric acid, and boiled until the evolution of gas ceases. The metallic precipitate left, when the precaution is taken to leave a little zinc undissolved, contains all the indium, together with the lead, &c. In the case of a solution containing indium—such as chloride of zinc, from which the discoverers obtained the new metal,—the separation may be effected by means of acetate of soda. This method depends upon the disposition of the oxide of indium to form a basic salt. A little dilute sulphuric acid is first added to the solution containing indium, and carbonate of soda is then added until, after stirring, a slight cloudiness remains; acetate of soda is then added, and the mixture is boiled. In this way a basic sulphate of indium, with a little iron, and zinc oxide is precipitated.

From a hydrochloric or nitric solution of indium the separation may be effected by carbonate of baryta, which perfectly precipitates the oxide in the cold. The precipitate usually contains some iron, but no zinc oxide.

To obtain the indium pure, the precipitate containing it is dissolved in nitric acid. Most of the lead is first removed by means of sulphuric acid; sulphuretted hydrogen is then passed through the liquor until the remainder of the lead, with the arsenic, cadmium, &c., are precipitated. The excess of sulphuretted hydrogen is then got rid of by boiling, and the liquor is then oxidised by means of chlorate of potash, and precipitated by excess of ammonia. In this way a good deal of the zinc present passes into solution; a small quantity, however, remains with precipitated oxides of iron and indium. The precipitate is now dissolved in dilute acetic acid, and again precipitated by sulphuretted hydrogen. A little zinc and iron still goes down with the indium, and will after six precipitations; so for the perfect purification an additional proceeding is necessary. The mixed sulphides are dissolved in hydrochloric acid; in this solution the ferric chloride is reduced to ferrous chloride by the evolution of sulphuretted hydrogen. Carbonate of baryta is now added, and then after twelve or twenty-four hours all the indium is found in the precipitate free from all impurities but baryta.

To obtain the metal, the oxide is carefully heated in a stream of hydrogen. In consequence of the volatility, the heat at first must not be great, and the gas stream must be passed slowly. After the reduction the metal will be found in small silver-looking buttons, which can be fused together under cyanide of potassium.

In colour, indium resembles platinum, but when beaten out it is whiter than lead. It marks paper strongly. It does not appear to lose its lustre in the air. Heated to bright redness, it burns with a violet blue flame, oxide being deposited on the sides of vessel in the form of a yellow crust. The specific gravity of the metal when rolled out = 7·362.

Indium seems to form only one oxide, InO. This is of a straw-yellow colour; on heating it becomes reddish brown. It easily dissolves in acid. The hydrate forms a bulky, white precipitate, completely insoluble in ammonia and fixed alkalies. All the known salts are white. The carbonate forms a bulky, white precipitate, soluble in carbonate of ammonia, but separating again when the solution is boiled; it is insoluble in carbonates of the fixed alkalies. The phosphate is white and bulky; the oxalate is a crystalline precipitate. The sulphate forms indistinct crystals. The nitrate easily crystallises from an acid solution in clusters of needles. The sulphide is precipitated from an acetic solution by sulphuretted hydrogen. Strong acids do not prevent the precipitation, but they do interfere with the precipitation by sulphide of ammonium. The bright yellow precipitate dissolves on being heated with the precipitant, but deposits again on cooling of a somewhat whiter colour.

The author determined the atomic weight in two ways, but the results were not concordant. At present it may be received provisionally at 35·918 if $O = 8$; or, 448·9 if $O = 100$.

On the Crystallisation of Supersaturated Saline Solutions, and the Normal Presence of Sulphate of Soda in the Air,† *by M.* D. Gernez.

The crystallisation of supersaturated saline solutions is one of the phenomena which has most taxed the ingenuity of chemists to explain; the uncertain circumstances under which it is produced, the variety of causes which appear to determine or prevent it, and the hypotheses put forward have all contributed to increase the importance of this subject.

Gay-Lussac has shown that a solution of sulphate of soda will remain at the ordinary temperature without crystallising, even when it contains several times the weight of the salt which it dissolves at this same temperature, but that it forms into a mass when a crystal of sulphate of soda or certain substances previously exposed to the air is thrown into it, or when the liquid is abruptly placed in contact with the air. Many chemists (Lœwel, Selmi, Goskinski, &c.) have varied and extended Gay-Lussac's experiments; they have brought to bear on the explanation of this phenomenon sometimes water vapour, sometimes atmospheric air, or an unknown substance, or glass vessels in a particular state, or finally a catalytic force. I believe I have shown that the crystallisation of a supersaturated solution of sulphate of soda is effected by contact with a fragment, efflorescent or not, of sulphate of soda, of ten equivalents of water. This appears to me to be the result of a number of experiments of which I can here indicate only the most important.

I. The Crystallisation of the Supersaturated Solution of Sulphate of Soda is Determined by the Fall of a Solid Body.—We know that supersaturated solutions exposed to the air in a laboratory always end by forming into a mass. By varying the experiments I have ascertained the conditions necessary for the crystallisation. It is always produced in matrasses or flasks, if the dust in the air will by falling vertically encounter the surface of the liquid. I found that in the same place the crystallisation is much more rapid where the surface directly in contact with the air is largest, or where the air has easiest access; it is very slow where the orifice is narrow, in which case it always begins at one point, whence it extends in all directions in the form of radiated needles, and if, for instance, this takes place in a balloon with a straight neck, this point is invariably in the horizontal projection of the orifice.

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* Journ. für Prakt. Chemie, bd. 94, p 1.

† Comptes Rendus, lx., 833.

By inclining the neck of the balloon or matrass containing the liquid while still hot, or by leaving in the usual position a retort filled with the liquid, no crystallisation takes place. It would, then, seem necessary that the corpuscles of the air should be able to reach the surface of the liquid in their vertical fall.

Several experiments, especially Lœwel's, would have led to the opinion that crystallisation is due to the presence of a solid body in the air, had not other, and apparently contradictory, experiments been made. Thus air which has traversed cotton or starch no longer determines crystallisation. I have found that all causes which arrest the movement of the solid bodies in suspension in the air produce the same effect. To ascertain this I merely repeated with supersaturated solutions the experiments made by M. Pasteur with putrescible liquids; among others, the experiment with balloons with sinuous necks.

Finally, hardly perceptible dust deposited on any body put in contact with a supersaturated solution always determines its solidification. It is the same with a thick layer of dust.

II. The Solid Body Determining the Crystallisation is Soluble in Water.—In a second series of experiments I found:—1. That the bodies determining the crystallisation of the supersaturated liquid lose their property when washed in ordinary water and dried, when cooled in flasks having a layer of sulphuric acid at the bottom. In the same way, dust slowly dried after being washed becomes perfectly inactive.

2. I passed into a supersaturated solution, which had remained intact, more than 1500 litres of air washed in distilled water, and, to use the least possible quantity of water, I passed the air through a series of inclined glass tubes, in each of which a drop of water uplifted by the bubble of air rose the length of the tube, diminishing in volume, and forming again in the lower part of the tube, thus serving an indefinite number of times.

3. A layer of oil poured on a solution of sulphate of soda preserves it from contact with the air and prevents its crystallising. In place of oil I employ a layer of water, when no crystallisation is produced by plunging a rod into the solution; at least, if this is done very rapidly and there is no thick coating of deposited matter on the rod, in which case should a morsel fall into the solution and not be completely dissolved, the solution will be crystallised before the rod has touched the supersaturated solution.

III. The Solid Body Determining the Crystallisation loses its Property under the Influence of Heat.—I verified this fact, which has long been established.

IV. The Air which Determines Crystallisation contains Sulphate of Soda.—I collected the few drops of water which had washed the air in the inclined tubes in experiment section II., and which contained the soluble matters of more than 1500 litres of air; they gave, with chloride of barium, a precipitate of sulphate of baryta; one drop of liquid gave, with the spectroscope, the soda ray with remarkable intensity.

Dust deposited even out of the laboratory, treated by distilled water, gave a lixivium presenting the same reactions, and contained considerable quantities of soda and of a soluble sulphate.

In short, the crystallisation of the supersaturated solution of sulphate of soda is determined by the contact of a solid body soluble in water, alterable under the influence of heat, giving with chloride of barium a precipitate of sulphate of baryta, and containing soda; these are exactly the characteristics of ordinary sulphate of soda, which would then determine the crystallisation of its supersaturated solutions.

But does no other substance possess this property? To clear up this synthetic side of the question, I tried the action of a great many substances; among 220 I found 39 possessing this property. Of these, 18 were insoluble; I washed them in distilled water, and left them on filters shielded from the dusts in the air; when, after a few days, they were dry, I found them without action on the solution which they previously crystallised. Moreover, the lixivium gave, with chloride of barium, a precipitate of sulphate of baryta, and contained soda. The 21 soluble substances I purified by recrystallisation with or without the addition of chloride of barium. Not one of them preserved its action on the supersaturated solution. These results lead me to believe that sulphate of soda is the only substance which acts on the supersaturated solution.

Let us now consider the action of the air in Gay-Lussac's experiment with a tube, as it is ordinarily made. If the conclusion at which I have arrived be correct, it is necessary that a particle of sulphate of soda should penetrate with the air into the tube, and so determine the crystallisation. Now it seems difficult to admit that in the limited volume of air entering into the tube there should always be a particle of sulphate of soda, but this experiment succeeds, at the most, once in six times, when the precaution is taken of washing the fine end of the tube, and the pincers which serve to break it and to keep it at a distance. If it is generally most successful in the lecture room, it is because the current of air takes with it particles of sulphate of soda which have been thrown from the tube during the boiling of the liquid, and which have become attached to the outer surface, and there crystallised. However, this experiment is of little use in resolving the question at issue, as it brings into contact with the solution only a very small volume of air. It is better to pass air very rapidly (one litre per minute) into a supersaturated solution; then, while in the laboratory, a quarter of a litre is sufficient to determine crystallisation; in the open country sixty and even eighty litres are often required. This result, obtained by avoiding all the causes which might accidentally introduce sulphate of soda, makes the existence of sulphate of soda in the air more and more probable.

There is, moreover, nothing extraordinary in the presence of this substance in the air, when we remember that sulphurous acid and sulphuretted hydrogen, produced in the air, are readily transformed into sulphuric acid, and that sea-salt, procured from sea-water, gives, with this acid, sulphate of soda.

Sulphate of soda is not the only substance which can give supersaturated solutions; acetate and carbonate of soda, sulphate of magnesia, &c., have the same property. I am now engaged in studying them, and intend soon to lay the results before the Academy, and hope to be able to deduce from them an analytical process applicable to substances suitable for supersaturation, by which their presence, even in infinitesimally small quantities, may be ascertained. All the dusts which I have essayed, and which contain crystallised sulphate of soda, have been actionless on the acetate; this salt being in fact very rarely present in the air.

I had the honour of assisting M. Pasteur in his experiments, at the Museum of Natural History, relative to generations called spontaneous; there I first thought of studying supersaturated solutions; their crystallisation being, as I believe I have proved, attributable to the action of particles of sulphate of soda held in suspension in the air, or deposited on the surface of bodies, there will doubtless be great similarity either in the mode of experimenting, or in the results, between my work and that of M. Pasteur relative to the inferior germs of organisation.

Casein of Milk and its Affinities,[*] *by MM.* E. MILLON *and* A. COMMAILLE.

In a previous communication[†] we indicated the regularly constituted combinations formed by casein of milk with various acids; we now purpose giving several fresh facts showing the particular direction of this affinity of casein for certain acids, and establishing, moreover, the composition of free casein, as well as the organic identity of soluble casein of milk with insoluble casein.

By treating sulphuric casein by a large excess of hydrochloric acid, we obtain a solution which is precipitated by bichloride of platinum, and the precipitate possesses the following composition:—

$$\underbrace{C_{108}H_{97}N_{14}O_{29}.SO_3}_{\text{Sulphuric casein.}} + HCl + PtCl_2 + 4HO.$$

Thus sulphuric casein acts as a new chemical unit, as does casein proper; and, like many salifiable organic substances, it may be displaced from its acid combinations by other acids; in this way phosphoric casein gives sulphuric casein when treated by sulphuric acid diluted with its volume of water. But sulphuric and phosphoric acids may be found simultaneously associated with casein, and this is a striking fact when we consider how frequently sulphur and phosphorus are found together in albuminoid matters.

The combinations of casein with acetic, hydriodic, perchloric, and hydrosulphocyanic acids are all decomposed by water; not one of them, however, is so easily destroyed as acetic casein, which we used to isolate casein. Having precipitated the diluted milk by acetic acid, we washed the coagulum with water, alcohol, and ether; we dissolved it in a very weak sodic ley, reprecipitated it by acetic acid, again washed it as before, and evaporated the ether, which softened the coagulum, in the open air, or in a vacuum. We obtained in this way a light milk-white powder, the combustion of which left only a few thousandths of ash.

This powder, except the traces of ash, was pure casein, insoluble in alcohol and in ether, and very slightly soluble in water. It contained 5 equivalents of water, which it lost progressively and in definite proportions, according to the temperature to which it was submitted; thus, up to 115° it abandoned 2·21 per cent., or 3 equivalents, and up to 150°, 3·71 or 5 equivalents.

Its formula is—

$$C_{108}H_{97}N_{14}O_{29}.5HO;$$

that is to say, a double amide of tyrosine and leucine. So much for the composition of soluble casein of milk.

Insoluble casein has the same elementary composition, but it differs from soluble casein in its state of hydration—containing, in fact, only 3 equivalents of water. We have ourselves no doubt as to the identity of the organic group forming the nucleus of the two caseins of milk. Now, taking into consideration the influence exercised on the elementary analysis of casein, by different degrees of hydration, by the annexment more or less complete of one or more acids, by the incorporation of various mineral or organic substances, and in very variable proportions; by taking into consideration all the disturbing influences in the estimation of casein, it will not be difficult to account for some divergence in the numbers given by several eminent chemists.

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[*] *Comptes Rendus*, lx., 859.

[†] *Ibid*, lx., 118.

On the Supposed Nature of Air prior to the Discovery of Oxygen, by GEORGE F. RODWELL, *F.C.S.*

(*Continued from page* 163.)

XII. Rise of Scientific Societies.—In the preceding paper we have considered the labours of the Accademia del Cimento in connexion with the subject under discussion, we have now to speak of two institutions which, unlike the Italian Academy, have endured to our time, and have year by year extended their influence on the progress of the Baconian philosophy, until they have become the very centres from which its greatest results emanate—the Royal Society and the Academie des Sciences.

A few years after the death of Bacon, some of the more ardent of the followers of the "new philosophy" agreed to meet weekly at each other's rooms for the trial of experiments, and for the discussion of subjects connected with experimental science; when the number of members of this infant society had somewhat increased, the meetings were held at the "Bull's Head" in Cheapside, and subsequently at Gresham College, but the latter was converted into a garrison during the Commonwealth, and the meetings were discontinued till 1660, when they were resumed at the College. The Society now received large accessions to its numbers, a journal book was commenced, and rules were drawn up relative to the election of officers and the admission of fellows. On December 5, 1660, it was notified to the members that Charles II. had received information of the establishment of the Society, and that he approved of its design, and desired to promote its welfare. In 1662 a charter was granted to the Society, rendering it a corporate body, under the title of "the Royal Society for improving natural knowledge." "*Nullius in Verba*" was chosen as the motto of the Society, and it may fitly be taken as the motto of the Baconian philosophy.

We have previously mentioned that Baptista Porta called one of his scientific works "Natural Magic" to distinguish it from contemporary writings on similar subjects, in which unusual physical effects were attributed to supernatural causes; now it was for a like reason that the Royal Society was defined as an institution "for improving *natural* knowledge." It was founded at a time when much of the superstition of the Middle Ages still prevailed, when it was no uncommon thing to burn those suspected of witchcraft, to cast horoscopes, to seek for hidden treasure with divining rods, to practise many of the old Chaldæan mysteries. The Society was to ignore all this; it was to look to natural causes for the explanation of new or hitherto unexplained phenomena, and to prove the fallacy of those superstitions which Bacon had spoken of as "mere levities that have little in them of certainty and solidity, and may be plainly confuted by physical reasons."[*] The influence of the Society in this direction was considerable, for we find a manifest lessening of superstition soon after its establishment.

Among the early Fellows of the Society were Ward, Wallis, Sir Robert Moray, Bishop Wilkins, and Robert Boyle; the latter laboured most indefatigably for the

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[*] "Advancement of Learning," book 3, chap 4.

good of the Society, indeed it may be considered as in a great measure due to his influence that it obtained a permanent footing. At the early meetings of the Society, the subjects discussed related chiefly to the Copernican theory, the spots of the sun, the Torricellian experiment, and the improvement of telescopes; experiments were made to determine the length of time that a candle continued to burn in a cubic foot of (*a*) common air, (*b*) rarefied air, and (*c*) condensed air; thin glass bubbles filled with air at the ordinary pressure were caused to swim in condensed air, and experiments were made on the increase of weight of some metals during calcination. It could not, however, be expected that the superstitious element so prevalent at this period would be entirely excluded from the discussions of the Society, especially when it numbered among its fellows such men as Sir Kenelm Digby and Sir Gilbert Talbot; nor was it at once excluded. Thus on June 26, 1661, we read that "Dr. Ent, Dr. Clarke, Dr. Goddard, and Dr. Whistler were appointed curators of the proposition made by Sir G. Talbot to torment a man presently with the sympatheticall powder." July 31.—Mr. Croune exhibited before the Society a jar full of the powder of the bodies of vipers, and another full of the powder of the hearts and livers of vipers. On September 4 Sir Kenelm Digby read an account of "a petrified city and its inhabitants." Even the divining rods were thought worthy of examination by these early philosophers; July 10 we read,—"The fresh hazell sticks were produced, wherewith tho divining experiment was tried, and found faulty."

At this period but little was known of foreign countries, and travellers were wont to grossly exaggerate the wonders they had seen; and more than this, often to state the most glaring impossibilities—for instance, that diamonds grew in the mines in which they were found, that there existed a river of pure balsam, that in certain countries the natives whistled so loud as to be heard at a distance of five miles, and such like absurdities; we remembor to have seen in the "Mundus Subterraneus" of Athanasius Kircher (a man who had travelled much) a detailed account, accompanied by an engraving, of an encounter with a dragon. At an early period of its existence the Royal Society sent a number of questions to residents in foreign countries, with a view of ascertaining to what extent the assertions of travellers might be relied upon, and further for the purposes of scientific inquiry. In 1661 a number of questions were sent to a resident in Teneriffe; they were proposed by Lord Brouncker and Robert Boyle, and many of them were obviously for the purpose of ascertaining the difference between the air on the summit of a lofty mountain and that at its base. The recipient of the letter was desired, among other things, to try the Torricellian experiment at the top and bottom of the mountain, and to note the exact difference in the height of the mercury column; to carry up partially inflated bladders, and to observe to what extent they altered in bulk at various elevations; to weigh a bottle of air at the top and bottom of the mountain; to observe whether birds loaded in such a way that they can just fly at the bottom of the mountain, are able to fly at its summit; to ascertain if there is any moisture in the air at the summit of the mountain, and if a siphon will act there readily.

The first number of the Philosophical *Transactions* was published on March 1, 1665, and from that date to the present the publication has been continued uninterruptedly. The early volumes contain a very miscellaneous collection of subject-matter; scientific articles were by no means alone admitted—sometimes we find two of the most diverse subjects treated of in the same communication; thus in the number for December, 1667, there is an "Extract of a letter written by Mr. Sam. Colepress to the Publisher, containing an account of some Magnetical Experiments; and also of an excellent liquor made of Cyder-apples and Mulberries." Astronomical papers occur rather frequently; medical papers less so; articles on pure physics are by no means common; the reviews of recently published books are of great interest and of frequent occurrence. We will briefly consider the various papers of importance connected with our subject which occur in the Philosophical *Transactions*.

1665. No paper relative to the air.

1666. Under the title of "*A New Statical Baroscope*," Boyle describes an apparatus for showing changes in the weight of the air, which he considers preferable in many respects to a mercurial barometer. At one extremity of the beam of a balance capable of turning with $\frac{1}{50}$th of a grain he suspended a sealed glass sphere full of air, about the size of a large orange; it was exactly counterpoised by a lead weight placed on the opposite extremity of the beam; minute movements of the beam were made apparent by an index which pointed to an accurately divided arc; the position of the sphere of course varied with changes in the density of the air, an alteration in which represented by a rise or fall of one-eighth of an inch in the mercurial barometer was clearly indicated by the statical baroscope.—Dr. Beal gives a number of barometrical observations, and states that he never found the mercury column higher than $30\frac{1}{4}$ inches, nor the extreme change to exceed $2\frac{7}{8}$ths inch. Dr. Wallis, during a great number of observations, did not observe the mercury higher than 30 inches or lower than 28; he found it rise in foggy and sunshiny weather, and fall in wet and windy weather. Boyle, in giving directions as to how barometers should be observed, urges the necessity of ascertaining the exact elevation above the level of the sea of two localities in which separate barometrical observations intended for after comparison are being made—a point of great importance, which up to that time had been overlooked. In detailing the "General Heads for the Natural History of a Country," Boyle writes as follows:—"Concerning the air, may be observed its temperature, as to the first four qualities and the measures of them; its weight, clearness, refractive power; its subtilty or grossness; its abounding with or wanting salts; its variations according to the season of the year, and the times of the day; what durations the several kinds of weather usually have, what meteors it mostly produces, and in what order they are generated, &c."

1667. Some experiments are mentioned by Dr. Beal relative to the growing of seeds in vacuo. Lettuce seed was planted in earth, part of which was placed in the open air, and part in vacuo; in eight days the seed which was planted in the open air had produced plants one and a-half inch high, while that in vacuo had not sprouted; on admitting air to the receiver, the included seed produced plants from two to three inches high in a week's time. In a short notice of "*An Experiment of Sigr. Fracassati upon Blood Grown Cold*," we find mention of an important fact hitherto unobserved—or at least unrecorded. The dark colour of venous blood had for a long period been believed to be due to an admixture of the "melancholy humour" (one of the four supposed constituents of blood); Fracassati observed, however, that when dark-coloured blood was exposed to the air its upper layer became bright red, while the blood beneath remained dark coloured; from whence he infers that the dark colour of blood is not due to the "melancholy humour," but to the want of an admixture of air, since the presence of air at once converts it into red blood.

1668. In the *Transactions* for this year we have an interesting paper by Boyle, entitled "*New experiments concerning the relation between Light and Air in shining wood and fish,*" in which we find, among others, the following experiments:—A piece of luminous rotten wood was placed under the air-pump receiver, on exhausting it ceased to emit light, but when air was admitted the luminosity returned. In order to see if the light could be perfectly extinguished like that of a red hot coal placed in a vacuum, pieces of luminous wood and fish were left in an exhausted receiver for from twenty-four to forty-eight hours on admitting air, the bodies immediately regained their luminosity. A piece of luminous wood was placed in a vessel into which air was compressed, but the wood did not shine brighter than before. A piece of luminous fish was placed in a bottle of water, which was included within a receiver, and the air exhausted, but no effect was produced. In order to ascertain whether "the cold fire" of shining wood could be maintained by a very small quantity of air, a piece of wood was hermetically sealed in a glass tube; it retained its luminosity perfectly for a length of time.

1669. No paper relative to the air.

1670. Boyle contributes an interesting paper entitled "*New pneumatical experiments about respiration.*" We have previously mentioned Boyle's experiments on respiration which he described in the first "Physico-mechanical experiments touching the air." In this paper we have a continuation and enlargement of his former experiments; those here described were principally made in 1662 and 1663. As ducks are able to remain for an appreciable time under water, Boyle conceived that they would form good subjects for experiment, accordingly he enclosed one in the air-pump receiver, and exhausted, whereupon the duck was brought to the point of death in a few minutes. A viper was alive at the end of two and a-half hours, during which it had been kept in an exhausted receiver; a second was enclosed in a very small receiver, which was well exhausted; at the end of an hour and a half it was to all appearance dead, but on admitting air twenty-three hours afterwards, it proved to be alive. A large frog placed in a receiver was observed to swell out considerably when exhaustion was commenced, in a short time it appeared to be dead; at the end of three hours air was admitted to the receiver, and the inflated frog immediately shrank up to a very small size, still to all appearance dead; nevertheless, on being placed overnight on grass in the open air, it was found to be alive and well the next morning. In order to ascertain whether animals "that had been lately accustomed to live either without any or without a full respiration would not be more difficultly or slowly killed by the want of air, than others which had been used to a free respiration," Boyle placed a kitten (born the previous day) in a small receiver, and exhausted, at the end of six minutes it appeared perfectly dead, but on removal to the open air it recovered after a while; a second kitten which was left in vacuo for seven minutes did not recover when air was admitted. An oyster was kept in vacuo for twenty-four hours, and remained alive; a crawfish also lived in vacuo; a leech which was kept in an exhausted receiver was found to be alive and well at the end of five days. The heart of an eel just taken out was placed on a tin plate in an exhausted receiver, it continued to beat for an hour. A gudgeon remained alive for some time in vacuo. From the numberless bubbles of air which ascend from water placed in vacuo, Boyle puts it as a query "whether in common water there may not be concealed air enough to be of use to such cold animals as fishes; and whether it may be separable from the water that strains through their gills." In order to see if the volume of air is altered by animals breathing in it until it is incapable of supporting life, birds and mice were placed in tubes together with a mercury gauge, the tubes were then hermetically sealed, and put aside until the animals and birds were suffocated; the gauge indicated no change in the volume of the air within the tubes. As it would be of service in our comprehension of the minuteness of a particle of air, if it could be proved that very minute insects breathe, Boyle placed a number of mites in a small receiver, and exhausted; on examining them with a lens, they were observed in a short time to become perfectly motionless, and to continue so, but on the admission of air they manifested considerable liveliness; whence he considers that it may be taken as proved that they breathe.

1671. The only paper of interest in connexion with our subject in this year's *Transactions* is a short one on "*The Compression of Air by water,*" in which the following experiment is detailed:—A glass bottle of a quart capacity was fitted with a valve opening inwards; it was sunk in the sea mouth downwards to a depth of thirty-three feet; on drawing it up, it was found to be half full of water, proving that the weight of a column of water of thirty-three feet high had compressed the air in the bottle to half its volume, as might have been predicted from the previous experiments of Boyle and Hooke on the compression of air by a column of mercury.

1672. When a tube five or six feet long, closed at one end, is filled with mercury perfectly free from air, and then inverted into mercury, after the manner of making the Torricellian experiment, the mercury in the tube will frequently be found to remain suspended at a much greater elevation than that at which the pressure of the atmosphere would cause it to remain; but if the tube be shaken, or if a slight blow be given to it, the column at once falls to its usual height of 30 inches above the stagnant mercury. In order to account for this, Huygens propounded a most unphilosophical theory (contained in a letter to the *Journal des Savans*, and reprinted in this year's *Phil. Trans.*), which affirmed that, in addition to the pressure of the air, there is a second pressure of a more subtle matter than air, which is able to penetrate glass, water, and mercury, and that it is due to this additional pressure that the mercury column under the above circumstances remains suspended above 29 inches. Although this hypothetical matter could penetrate glass, Huygens conceived that so long as the mercury was absolutely in contact with the end of the glass tube, so that there was no free space in the tube, it could not be readily pressed upon, but upon shaking or jarring the tube the mercury was separated from its close contact therewith, and the subtle matter immediately rushed in and caused the descent of the mercury. He conceived further that the presence of this additional pressure was proved by two experiments: the one, that a siphon will act *in vacuo*; the other, that two perfectly plane plates placed in contact will not separate *in vacuo* any more than in air, although a weight may be attached to them.

The Académie des Sciences was founded in 1666, mainly by the exertions of Colbert, Carcavy, Auzout, Huygens, and Roberval. During the century it published ten volumes of proceedings, known as the "Anciens Memoires de l'Académie." In 1699 the Academy underwent an entire reorganisation, and from that time to the present the memoirs have appeared more frequently.

There are only two papers of interest in connection with our subject which appeared before 1673 (to which date we have taken our notices of the *Philosophical Transactions*). The first is "On the Augmentation of Weight of Certain Matters during Calcination." In this the author, M. du Clos, gives the following explanation of the cause of the increase of weight observed. He conceives, "Que l'air qui coule incessamment vers les endroits, où il y a du feu, laisse surces matieres embrasées pleine de souffres terrestre, des particules sulphurées plus volatiles, qui s'unissent avec eux, s'y fixent, et forment ces filamens dont nous avons parlé, qui sont apparemment toute augmentation du poids." The other paper details some vacuum experiments, almost all of which had been previously made. No mention is made of Boyle's air-pump, and Otto Guericke's form of the instrument was apparently employed. In order to ascertain whether heat passed as readily through a vacuous space as through air, some butter was placed in a receiver, and a hot iron held as near to it as practicable outside the receiver. The butter did not melt so readily when the receiver was exhausted as when it was full of air, probably, according to the author (whose name is not mentioned), because air, in virtue of the grossness (grossièreté) which it possesses, is more capable of conveying heat from the hot side of the receiver to the butter than the very thin and subtle matter which remains in the receiver after the air has been pumped out.

TECHNICAL CHEMISTRY.

Preparation of Aniline Green.[*]

One part of fuchsine is treated with a mixture of one and a half parts of sulphuric acid and half a part water, and the whole is gradually heated to dissolve the fuchsine; after the solution has cooled four parts of aldehyde (prepared as below) are added. Heat is then carefully applied to the mixture, and as soon as it becomes of a bright blue colour the heat is withdrawn. The colour is best observed by letting a drop or two fall into water acidulated with sulphuric acid. The heat must be continued until no violet shade is seen. When the change to blue is perfect boiling water and hyposulphite of soda are added simultaneously, the mixture is stirred and thrown on a cloth filter. The residue is washed with quite boiling water until it is all dissolved. The filtrate is then allowed to stand for twenty-four hours, and is then again filtered. The mass now remaining on the filter is the green colour, which is dried at 30° to 38°, and then powdered.

Manufacture of Aldehyde for the Preparation of Aniline Green.[†]

Three hundred and fifty parts of sulphuric acid are first diluted with 150 parts of water, and when the mixture has cooled 820 parts of alcohol are gradually added. The mixture is placed in a vessel of glass or earthenware fitted with a tube and stopcock. In a tubulated retort 300 parts of bichromate of potash in small pieces and 150 parts of water, are placed. The tubulus of the retort is fitted with a funnel, and heat being applied, the mixture of sulphuric acid and alcohol is allowed to run gradually into the retort. The aldehyde distils over, and may be collected by the ordinary appliances. It requires one or two rectifications.

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[*] *Chem. Central Blatt*, 1865, p. 368.

[†] *Ibid.*, 1865, p. 383.

THE

DUBLIN INTERNATIONAL EXHIBITION.

By Chas. R. C. Tichborne, *F.C.S., F.R.G.S.I.*, &c.

(Specially Reported for the Chemical News.*)*

(Continued from page 283.)

Messrs. Bell, Brothers, of Newcastle-upon-Tyne, exhibit some aluminium, but as this metal is only used in this instance for decorative purposes we shall not dilate upon the beautiful statuettes and groups which are exhibited by the above firm. From these specimens no doubt can be entertained of its applicability to these purposes. Although some doubt was formerly expressed, its preservative properties have been since well proved, and if sufficient purity is attained the metal is practically untarnishable.

Scientific Instruments.—Mr. Spencer, of Dublin, in a neat case containing some very good chemical and other instruments, shows one of Professor Jellett's saccharometers. As this form of saccharometer is little known on the other side, and as it is a matter of some importance, I may make no apology for dwelling at some length upon the subject now in hand. The original description will be found in the *Transactions* of the Royal Irish Academy.

Professor Jellett says that his saccharometer is capable of giving more accurate results than those obtained by means of the instrument of Soleil. He adds, that as far as he can judge, both from his own experiments and the report of others who had used it, the errors to which even an accurate observer would be liable, in attempting to estimate the strength of a saccharine solution, could not be reckoned as less than half a grain per cubic inch for a single observation. The following diagram represents Professor Jellett's instrument:—

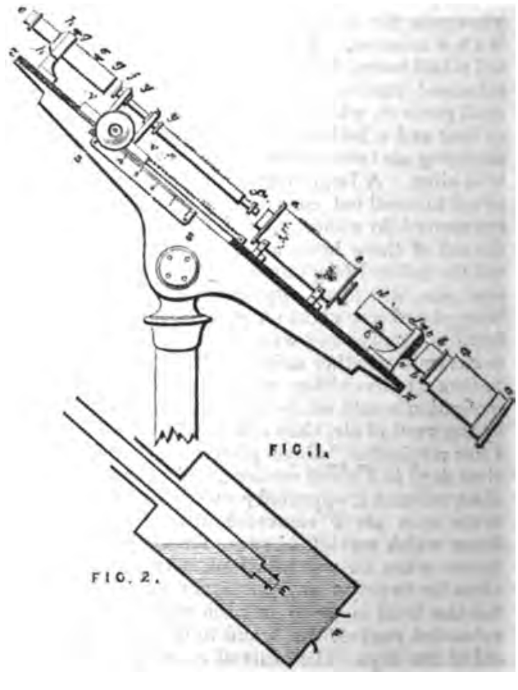

FIG. 1.

FIG. 2.

a a is a short tube containing two large lenses serving to condense the light of a lamp which is placed as nearly as possible in the principal focus of the lower lens. *b b*, *c c* is a short tube carrying at one extremity a lens *c c*, and at the other extremity a diaphragm *b b*, pierced at its centre by a small hole O, which is situated in the principal focus of the lens *c c*, and also when the instrument is adjusted, in the principal focus of the upper lens *a*. By this arrangement a beam of light is obtained emerging from *c c*, sensibly parallel to the axis of the tubes. This beam is polarised by being transmitted through a Nicols' prism contained in the tube *d d*; *e e* is a vessel pierced at the lower end by a circular hole, which is closed with plate glass. This vessel contains a fluid possessing a rotative power opposite to that of the fluid under examination. This latter fluid is contained in the tube *f f*, which rests on the two upright pieces *y y*. These pieces are attached to the transverse pieces *v v*, which carries a Vernier, whose dimensions correspond to those of the scale *s s*, which is attached to the bar *z z*, which carries all the parts of the instrument. The transverse piece *v v* is capable of sliding along *z z*, this motion being produced by a chain attached at both ends to *z z*, and passing round a spindle with a milled head attached to *v v*. By these means a motion can be given to the tube *f f* parallel to its own axis, and by a simple arrangement the zero of the Vernier is made to coincide with the zero of the scale when the extremity *f* of the tube is in contact with the piece of glass covering the lower aperture in the vessel *e e*. It is plain, then, that the numbers read on the scale, which is graduated so as to be read to 0·001 inch, will denote the length of the column of fluid E F (Fig. 2) interposed between the bottom of the vessel and the bottom of the tube; *g g* is an analysing prism, constructed according to Professor Jellett's plan*; *h h* is a lens, and *l* a diaphragm with a small hole, at which the eye of the observer is placed.

The polarising and analysing prisms are fixed in their places by small screws σ, σ', each passing through a transverse slit in the outer tube, so that when partly unscrewed they allow the prisms to turn through a small angle round the axes of the tube. In using the instrument, the polarising prism may be set in any position, the analysing prism being then carefully adjusted so that the tints seen in the two halves of the circular spectrum may, when there is no fluid interposed, be exactly equal. Suppose, now, that the object is to ascertain the strength of a given solution of cane sugar. In this case the fluid to be used in the vessel F E may be French oil of turpentine. A certain quantity, the amount of which depends on the strength of the solution to be observed, having been poured into the vessel, the tube *f f* is then filled with a solution of sugar whose strength is accurately known. The tube is now replaced in the upright pieces, and the zero of the Vernier made to coincide accurately with the zero of the scale. The milled head is now turned so as to draw back the tube until the tints on the two parts of the circular image seen through L become equal; the number on the scale corresponding to the zero of the Vernier is then noted. Let this reading be R, and let S be the strength of the solution.

This solution is then removed from the tube, which is then to be filled with the solution whose strength is required. The same process having been gone through, let the new reading be R'; then the strength required is given by the equation:—

$$S' = \frac{R'}{R} . S.$$

If the experiment be carefully conducted, and if there be no error in the strength of the standard solution, the error in the measurement made as above described, ought not to exceed 0·02 grs. per cubic inch for a single experiment, and if the mean of a number of experiments be taken the error will of course be less.

It is not desirable to use a very strong solution of the substances to be examined. No general rule can be given for determining the strength of this solution which it is desirable to use. If the law of Biot, that the amount of rotation produced by the same substance in the planes of polarisation of the different simple rays are proportional to the squares of the corresponding indices, be strictly true, then the more nearly these indices are in the same proportion for the fluid under examination and the compensating fluid, the stronger may be the solution used. If the fluid under examination be a saccharine solution, and the compensating fluid French oil of turpentine, a solution containing in each cubic inch thirty grains of sugar may be used without inconvenience.

The importance of such an instrument to the practical chemist is at present hardly appreciated. The writer had some experience in connexion with the verification of turpentines some short time since, which was effected by the aid of Professor Jellett's instrument. French turpentine and American turpentine have opposite rotatory powers, whilst the turpentine substitutes, or products of American mineral oils, are inert; not only can, therefore, a qualitative investigation be instituted, but a quantitative one may be performed. Professor Jellett's investigations in connexion with the distribution of acids and bases in solution and upon the alkaloids (part of them are still unpublished), are some of the most curious that we have come across for some time. We must confess that in spite of precedent we should prefer a better name than a saccharometer for this instrument. Professor Jellett evidently sees this, for he remarks that the name is derived from one important use to which it may be applied. "This, however, is only one of its applications, and there are many others at least as important. It may generally be defined to be an instrument by which the ratio of the rotatory power of any transparent fluid to that of a standard fluid may be accurately determined."

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 15.

Prof. W. A. MILLER, *M.D., F.R.S., President, in the Chair.*

THE minutes of the previous meeting were read and confirmed. Mr. William Marriott, Huddersfield, and Mr. Charles Umney, 40, Aldersgate-street, London, were proposed as candidates for election into the Society. For the second time were read the names of Mr. Frederic Row, Colchester, and Mr. James Parkinson, Royal School of Mines. Mr. George Bacon Sweeting, Surgeon, King's Lynn, Norfolk, was balloted for and duly elected a Fellow of the Society.

Dr. FRANKLAND gave an interesting account of the researches lately undertaken by Mr. Duppa and himself, "*On the Transformation of the Lactic into the Acrylic Series of Acids.*" By the action of terchloride of phosphorus upon the ethers of the lactic group, the authors had succeeded in effecting a variety of transformations, resulting in the production of acids belonging to the acrylic series. These changes were effected by the replacement of two atoms of hydrogen in the original body by an

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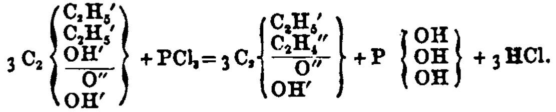
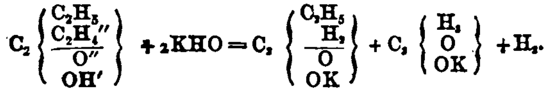
* *Proceedings* of the Royal Irish Academy, vol. ii., p. 348.

olefine, and differed, therefore, from the simpler cases of transformation formerly described, in which the oxygen of oxalic acid, for instance, was replaced by one atom of hydrogen and one of an organic radical (as in lactic acid), or by two distinct organic radicals. The principle of Dr. Frankland's investigation is well seen in the following example, wherein leucic (diethyloxalic) acid is converted into ethyl-crotonic acid, thus,—



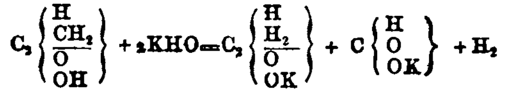
$$3\,C_2\left\{\begin{array}{c}C_2H_5{}'\\C_2H_5{}'\\OH'\\\hline O''\\OH'\end{array}\right\}+PCl_3=3\,C_2\left\{\begin{array}{c}C_2H_5{}'\\C_2H_4{}''\\\hline O''\\OH'\end{array}\right\}+P\left\{\begin{array}{c}OH\\OH\\OH\end{array}\right\}+3\,HCl.$$

Instead, however, of employing the acid itself in these reactions, it was found more advantageous to operate upon their respective ethers. The product of the above reaction was a liquid of specific gravity ·9203, and having an odour partaking both of the character of mushrooms and oil of peppermint. Its boiling point was 165° C., and observed vapour density 4·83, the number demanded by theory for the two-volume vapour being 4·90. The copper, silver, and other metallic salts of ethyl-crotonic acid were prepared and examined. The physical properties both of the acid and its compounds were not identical with those exhibited by the substances obtained by the old mode of production; so that the new body was isomeric with the ordinary ethyl-crotonic acid. The action of phosphoric anhydride upon leucic ether was described as giving the same results as the terchloride of phosphorus. By the action of hydrate of potassium, ethyl-crotonic acid furnished a mixture of butyrate and acetate of potassium, with liberation of hydrogen gas, thus—



$$C_2\left\{\begin{array}{c}C_2H_5\\C_2H_4{}''\\\hline O''\\OH'\end{array}\right\}+2KHO=C_2\left\{\begin{array}{c}C_2H_5\\H_2\\\hline O\\OK\end{array}\right\}+C_2\left\{\begin{array}{c}H_3\\O\\OK\end{array}\right\}+H_2.$$

Acrylic acid itself submitted to the same treatment furnished likewise an acetate as the invariable product, with simultaneous generation of an alkaline formiate, thus—

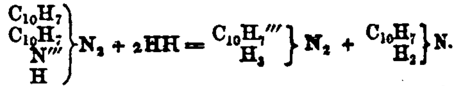


$$C_2\left\{\begin{array}{c}H\\CH_2\\\hline O\\OH\end{array}\right\}+2KHO=C_2\left\{\begin{array}{c}H\\H_2\\\hline O\\OK\end{array}\right\}+C\left\{\begin{array}{c}H\\O\\OK\end{array}\right\}+H_2$$

It was interesting to know that when ethylo-methyl-oxalic ether was treated with the chloride of phosphorus the ethyl radical was attacked in preference to the methyl, and the product was therefore methyl-crotonic acid; but when lactic ether was submitted to the same process it did not yield results homologous with the foregoing, but furnished the chloropropionic acid of Ulrich and Würtz. In this case the hydroxyle was replaced by chlorine, and not by an organic radical. A comparative view of the constitution of the several members (eleven) of the acrylic group, and of the three series of acids under discussion, was shown by the aid of large diagrams, and Dr. Frankland concluded with some general remarks upon the numerous isomerisms brought to light during the progress of these researches, and suggested the possibility of establishing by future investigation the replacement of three atoms of hydrogen by one of a triatomic radical.

In reply to the President and Dr. Gladstone, the lecturer said that the physical study of the series of isomeric bodies just now described was as yet far from complete; and in answer to Mr. G. C. Foster's objection to the scheme of nomenclature, Dr. Frankland admitted some inconsistencies, and said it would have been better to start from lactic instead of oxalic acid; but these appellations had been adopted by Würtz, and, now that the ground had been taken from under their feet, it was difficult to set about framing an entirely new system; but the authors had made some progress in this direction when their revolutionary proposals were threatened by the almost unpronounceable character of the names; thus, methyl-acrylic acid should be called methyl-methylene-acrylic acid, and ethyl-crotonic acid might be described under the non-euphonious name of et-etheno-crylic acid.

Mr. W. H. **Perkin** then read a paper "*On the Action of Nascent Hydrogen on Azodinaphthyldiamine.*" The author digested an alcoholic solution of the base with metallic tin and hydrochloric acid until the violet colour gave place to a pale buff tint. The solution being evaporated, and the tin removed from solution by sulphuretted hydrogen, a mixed product was obtained, which was prone to oxidation. Upon addition of hydrochloric acid, crystals were deposited which consisted of the mixed hydrochlorates of two bases, viz., naphthylamine and naphthyldiamine; their formation was thus explained:—



$$\left.\begin{array}{c}C_{10}H_7\\C_{10}H_7\\N'''\\H\end{array}\right\}N_2+2HH=\left.\begin{array}{c}C_{10}H_7{}'''\\H_3\end{array}\right\}N_2+\left.\begin{array}{c}C_{10}H_7\\H_2\end{array}\right\}N.$$

Azodinaphthyldiamine. Naphthyldiamine. Naphthylamine.

By the addition of an alkali to the hydrochlorate or other salt of the new diamine the base is liberated in the form of beautiful glistening scales; but the colour of the solution is quickly changed to a dull green by absorbing oxygen from the air (shown by experiment). By distillation in hydrogen the pure base was obtained in the form of a pale yellow oil, which solidified on cooling into a nearly white crystalline mass. Its boiling-point is above the range of the mercurial thermometer. It is soluble in alcohol, ether, and benzole. The sulphate and hydrochlorate were obtained in a state of purity and analysed; the nitrate and oxalate were likewise prepared. Mr. Perkin here showed the magnificent green colouration which ferricyanide of potassium imparted to solutions of naphthyldiamine, and the subsequent effect of ammonia in changing this tint to violet—reactions which served to distinguish this base from naphthylene-diamine. The author then described the steps of the process by which he had succeeded in isolating pyridine from the mother liquors of the naphthyl-hydrochlorates, and remarked that its occurrence was interesting from the circumstance that the base had never before been obtained excepting as a product of destructive distillation. The formula of pyridine being exactly one-half that of naphthyldiamine suggested the possibility of splitting up the last-named substance; but up to the present time the author had not succeeded in obtaining pyridine by such a process.

The **President** remarked that the last statement of the author reminded him of Dr. Anderson's results in the production of picoline.

The **Secretary** announced the titles of three papers received from Professor Church—1. "*Note on a Cornish Mineral of the Atacamite Group;*" 2. "*On a New Ferric Hydrate from Cornwall;*" 3. "*Analyses of some Ancient Bronzes found in Great Britain.*" Mr. Robert Warington, jun., had likewise promised to send a communication, but it had not yet arrived.

The **President** said that, as time did not permit of reading these papers, they would be in due course printed in the Journal; and, after passing a vote of thanks to the respective authors, the meeting of the Society was adjourned until after the recess.

ACADEMY OF SCIENCES.

June 12, 1865.

M. H. St. C. **Deville** communicated a memoir, entitled, "*Critical Researches on the Constitution of the Compounds of Niobium.*" The author considers he has proved that the hypochloride of niobium of Rose is really an oxychloride,—a conclusion Marignac had arrived at before, Rose's Nb_2Cl_3 (Nb = 48·3) being, according to Marignac, $Nb_2O_2Cl_3$ (Nb = 47). M. Deville believes that all the seemingly extraordinary properties of niobium may be brought under the common laws.

M. Meunier read a continuation of his memoir "*On the Solution of some Metallic Oxides in Fused Caustic Alkalies*," the first part of which we have recently printed (see *ante*, p. 242). He has now analysed the violet compound formed when binoxide of mercury is dissolved in fused potash, and found it to be composed of binoxide of mercury 81·9; potash determined by difference 18·1. The formula $KO,2HgO$ requires binoxide 82·1, potash 17·9. When protoxide of bismuth is dissolved in fused potash, the solution becomes of a deep red colour. Being treated with water, a deep brown powder is left, which does not contain a trace of potash, and which the author regards as bismuthate of oxide of bismuth, or Bi_2O_4. M. Meunier has also studied the behaviour of the earthy oxides with fused alkalies. All dissolve easily in potash, but less easily in soda. 100 parts of potash will dissolve about 50 parts of lime or magnesia, and 30 of strontia or baryta. These solutions of the earthy oxides appear to have a strong affinity for oxygen, and possess the power of bringing metals to their highest state of oxidation. Silver, iron, copper, and lead dissolve in the earthy alkaline solutions; so do tin, antimony, and even platinum. Gold does not dissolve. Some of the solutions part with the oxygen again as they cool, and spirt like fused silver. The author believes that alkaline peroxides are formed in the reactions. We shall translate this paper as we did the former.

M. Persoz added another chapter to his memoir "*On the Molecular State of Bodies*." This one relates to the capacity of saturation. The capacity of saturation in oxides is proportional to the quantity of oxygen they contain. Acids with very different proportions of oxygen will unite with equal quantities of bases. This latter fact is owing to the acids containing one or more equivalents of oxygen in a particular state—*polar oxygen*; and M. Persoz believes that the saturating power of an acid is proportional to the number of equivalents of polar oxygen which it contains. Mono- bi- and tri-basic acids contain 1, 2, and 3 equivalents of such oxygen. The existence of this polar oxygen, the author says, helps us to explain a great number of chemical reactions.

The study of the laws of the composition of salts has led M. Persoz to establish the following propositions:—

1. The molecule of inorganic acids, with few exceptions, contains an uneven number of equivalents of oxygen.

2. Organic acids in which we find an uneven number of oxygen equivalents are all either monobasic or tribasic. Those which contain an even number are either bibasic or quadribasic.

3. In saline compounds the sum of the oxygen equivalents in acid and base is always an *even* number.

4. The oxygen, directly or indirectly, impresses on saline compounds by condensing them, a volume having a simple relation with its own.

5. When two bodies combine it is always in simple relations of volume.

MM. Maréchal and Tessié du Motay presented a memoir "*On Vitrified Photographs*." This does not admit of condensation, so we shall give it at length in an early number.

M. Corenwinder communicated "*An Analysis of a Tropical Seaweed*," Sargassum buciferum, the only thing remarkable in which is the amount of phosphoric acid found. Although, says the author, the phosphoric acid in sea water is in too small amount for the chemist to detect, marine plants find sufficient for their wants.

M. Carlevaris sent a note "*On a New Mode of Producing a Fixed Light, Constant and White.*" The author burns carbon, upon which he places a piece of chloride of magnesium, in the oxyhydrogen flame; or he makes cakes of carbonate of magnesia, and uses them in place of lime cylinders with the same flame.

NOTICES OF BOOKS.

The Phenomena of Radiation as Exemplifying the Wisdom and Beneficence of God. By George Warington, F.C.S., (Actonian Prize Essay). London: Skeffington. 1865.

As chemists we have happily no call to discuss the value of "Evidences of Design" and "Exemplifications of Beneficence," either in convincing the atheist or in supporting the believer. It is a more agreeable duty on the present occasion to recognise in this work great scientific knowledge, rare literary skill, and an admirable moderation of tone. The book will be read with pleasure by all who take it up, and we believe it will prove the most popular of the Actonian Essays. To the student it will bring the great truths of science, set forth in warmer language than would be appropriate in a class book; while for the general and religiously-minded reader it offers the double attraction of sound scientific teaching with the inculcation of a reverential faith.

The nature of the work unfortunately almost precludes the possibility of making an extract which will do both the author and his subject justice; but we select two.

The first answers the question—What is radiant force? "Our conception, then, of the exact nature of radiant force must be somewhat as follows:—It is occasioned by the exceedingly free and rapid vibrations of the surface particles of the radiating body, which vibrations are communicated to the particles of an all-pervading æther, and carried along by their means with extraordinary velocity. The slowest and longest of these vibrations produce the sensation of heat, which gradually rises in intensity as they increase in speed, until it reaches its maximum somewhat below the red end of the spectrum. Then the heating power again diminishes, and shortly afterwards, as the speed of the vibrations increases, the sensation of dull red light is produced. By a still greater increase of speed the heating power vanishes altogether, the red brightens, passes into orange, and at last yellow, where is the maximum of luminosity. The speed rising still higher, the yellow passes into green, and the green into blue, where chemical potency begins to show itself, increasing rapidly as the blue passes into violet, and attaining its maximum somewhat beyond that end of the spectrum. After this it, too, diminishes, and the vibrations probably cease altogether.

"The conversion of heat, light, and actinism (as the chemical power of light is called) into each other is thus seen to be simply a change in the *rate* of undulation, produced by the particles of the absorbent matter being caused to vibrate at a different rate from that of the communicating æther; much in the same way, probably, as musical sounds are capable of producing in absorbent bodies not only their own notes, their own vibrations, but also their *harmonics*, vibrations bearing a simple relation to their own. The conversion of these forces into ordinary motion, and their production therefrom, are also seen to be readily explicable, as a mere change of the mode or form in which motion acts."

After thus describing the nature and the laws of Radiation, the author proceeds to consider it as the Distributor of Light and Heat, as the Mainspring of Meteorology and Climate, as the Physical Cause of Vegetable and Animal Life, and lastly, in its Relations to Geology and Astronomy, and in this last section we find a remarkable and suggestive passage:—

"One more lesson there is, which this grand science has still to teach, a most appropriate conclusion of the whole. Among all these glorious worlds, lit up and energised, as we have every reason to believe they are, by radiant force emitted by their central orbs, have we accounted for *all* that force accomplishes? Take our own system as a sample. As already noted, but $\frac{1}{2,300,000,000}$th part of solar radiation is expended on the earth. A little also goes to other planets, more, no doubt, than to the earth; but even then what a minute fraction of the whole must this amount to. What becomes of all the rest? We cannot tell. Scattered into space on every hand, to all appearance it does nothing. Even that little employed upon the planets is ultimately cast forth again in like manner into space. The same takes place in all those million other systems with the radiation they enjoy. Whither goes this wondrous store of force? There is no power in space to change it, much less destroy it altogether; the very science of astronomy depends for its materials on the fact that radiation is *not* changed or stayed upon its course in passing through it. Yet there seems no object in the Universe for which this force exists. To conclude it therefore useless, waste, would be to ignore the whole array of facts that science sets before us, to put our lack of knowledge of its purpose for knowledge of its lack; besides, still leaving the main difficulty unremoved—if it be useless, still, *what becomes of it?*"

We have no space for more, and must conclude by recommending all our readers to peruse and enjoy this essay for themselves.

Bulletin Mensuel de la Société Chimique de Paris, May, 1865.

We have here the first instalment of an account by M. Joulin of the "*Potashes and Sodas of Stassfurth.*" These extraordinary mineral deposits have not yet been adequately described in English, almost the only notice they have received being contained in Dr. Hofmann's Exhibition Report (p. 47). In these deposits upon a very deep bed of rock salt rests a layer of Kieserite (chiefly sulphate of magnesia), and upon this again a bed of Carnallite, a mineral composed of the chlorides of potassium and magnesium. Here, as M. Joulin remarks, we have the salts lying in the order of their solubility, which goes to prove that they were deposited from a slowly evaporated solution. Some considerations lead to the supposition that the evaporation took place at a temperature lower than 50° C., the principle of which is that no sulphate of soda is formed, a salt that must have been formed from the reaction of sulphate of magnesia on chloride of sodium at a temperature but little above 50°. These deposits are now worked with great vigour, and in the year 1864, 115,327,000 kilogrammes of the potash compound were extracted from the mines and delivered to the manufacturers. The price of the rough material has, since March this year, been 1 fr. 62 c. per 100 kilos.

An important paper was contributed to the Prussian Society by M. A. Semenoff, "*On the Law of Volumes in Chemical Double Decompositions.*" The author enunciates the following laws:—(1.) In decompositions with bodies in the state of gas or vapour, the sum of the volumes of the molecules of the reacting bodies is always equal to the sum of the volumes occupied by the molecules of the bodies formed in the reaction; and (2) in double decompositions between liquids and solids, the molecular volumes taken at the usual temperature before and after the reaction, remains unaltered, and, just as in the case of gases and vapours, the sum of the molecular volumes of reacting bodies is equal to the sum of the molecular volume of the bodies formed. The author gives numerous illustrations of these laws, and draws the following conclusions:—

1. The final result of all decompositions is a simple juxtaposition of atoms without sensible condensation. Changes of volume can only take place at the moment of reaction.

2. The production or absorption of heat in double decompositions can only be regarded as equivalent to internal molecular work, which is not employed to keep the atoms at a distance after the reaction.

3. We can calculate with sufficient nearness the theoretic specific weight of a solid or liquid body, in the same way as we can find the theoretic density of a gas.

4. The law enunciated may be of great utility in the study of water of crystallisation, and the phenomena that supersaturated solutions present.

It may be as well to give an example, and we select one illustrating the second proposition above:—

Formation of Chloride of Sodium.

$$\left.\begin{matrix}\mathrm{H}\\ \mathrm{Cl}\end{matrix}\right\} + \left.\begin{matrix}\mathrm{Na}\\ \mathrm{H}\end{matrix}\right\}\Theta = \left.\begin{matrix}\mathrm{Na}\\ \mathrm{Cl}\end{matrix}\right\} + \left.\begin{matrix}\mathrm{H}\\ \mathrm{H}\end{matrix}\right\}\Theta.$$

$$28{\cdot}745 + 18{\cdot}779 = 29{\cdot}074 + 18.$$

$$\text{Total: } 47{\cdot}944 = \text{Total: } 47{\cdot}04.$$

$$\text{Chloride of sodium } \left.\begin{matrix}\mathrm{Na}\\ \mathrm{Cl}\end{matrix}\right\} = 58{\cdot}468 \text{ (molecular weight.)}$$

$$\left.\begin{array}{lll}\text{Specific weight} & = 2{\cdot}078 \text{ Karsten} & = 28{\cdot}137 \\ \qquad\text{,,} & = 2{\cdot}011 \text{ Joule \& Playfair} & = 29{\cdot}074\end{array}\right\}\begin{array}{l}\text{(mole.}\\ \text{vol.)}\end{array}$$

The other papers communicated to the Paris Chemical Society we have noticed already in our reports of the Academy of Sciences, and we find nothing new in the abstracts of foreign papers.

The Simplicity of the Creation; or, the Astronomical Monument of the Blessed Virgin; a New Theory of the Solar System, Thunderstorms, Waterspouts, Aurora Borealis, &c., and the Tides. Dedicated to the Mother of God. By William Adolph. London: Burns and Lambert. 1864.

There are many reasons why we cannot notice this book at length; but we have no objection to say that it is evidently the work of a man who has read largely and thought much; and if we have found it impossible to agree with his scientific conclusions—opposed, as we believe, to all demonstrated truth when the subject is open to demonstration, and in general to probabilities when the matter is only open to speculation—we may still admire the piety and earnestness of the writer.

The Declaration of Students of the Natural and Physical Sciences. London: Simpkin and Marshall. 1865.

The list of signatures to this now celebrated declaration has been published, and for the small charge of twopence any one can possess this Directory of Orthodoxy. That is all we can say about it.

Chemisches Central Blatt, Nos. 23 and 24.

The first of these two numbers is for the most part filled with abstracts from English sources, and the second is mainly occupied by papers we have already noticed. But we find some short account of the "*Preparation of Aniline Green, and the Manufacture of Aldehyde,*" which we transfer to our pages. Short notices of a "*New Process of Making Mosaic Gold,*" and "*On a Mode of Coating Copper with Antimony,*" will be found among our "Miscellaneous" paragraphs.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

477. W. E. Gedge, Strand, "A chemical combustible substance and apparatus to which it is applicable."—A communication from F. Stoker, Faubourg St. Martin, Paris.—Feb. 20, 1865.

1064. W. Beardmore, Parkhead, Lanarkshire, N.B., "Improvements in the arrangement of furnaces used for puddling and re-heating iron, the generation of steam and other similar purposes."—April 13, 1865.

1352. W. Wright, Mostyn, Flintshire, "Improvements in the treatment of the waste liquors obtained after heating burnt ores of copper, such improvements having for their object the production or extraction of cobalt and nickel." May 16, 1865.

1424. J. A. Coffee, Gracechurch Street, London, "Improvements in the retorts used in the manufacture of gas and in other distillations, which improvements are adaptable to evaporating vessels."

1428. R. Maxwell, Glasgow, N.B., "Improvements in applying coal-tar colours to cotton and linen."

1438. H. Gibbs, Hampstead Road, "Improvements in the manufacture of artificial fuel, applicable chiefly to the kindling of fires."

1443. M. Henry, Fleet Street, "Improvements in treating fibrous materials and textile fabrics, and in producing soap." A communication from L. Pasquier, and A. J. Dumout, Boulevart St. Martin, Paris.—May 25, 1865.

1448. R. Canham, Clerkenwell, "Improvements in cupola and other blast furnaces."

1450. C. B. Spaeth, Philpot Lane, London, "A new preparation for subduing and extinguishing fire." A communication from G. Leisler, Leipsig, Saxony.—May 26, 1865.

1456. R. A. Brooman, Fleet Street, "A new method of manufacturing oil from fatty matters or the residuum arising from the distillation of fatty matters, the manufacture of stearic acid soap, and purification of oils." A communication from P. R. Beaumont, Paris.

1460. L. Moser, Southampton, "Improvements in the manufacture of steel, and in furnaces used in such manufacture." A communication from J. Paulis, Liège, Belgium, May 27, 1865.

1480. J. Hibell, Nechells, near Birmingham, "Improvements in annealing pots and saucers, for annealing iron and steel wire, sheet metal, and other articles."

1486. R. H. Collyer, Brompton, Middlesex, "Improvements in the process and apparatus for the treatment of materials for the manufacture of paper and other purposes."—May 30, 1865.

1498. T. Summerson, Darlington, "Improvements in foundry cupolas."—May 31, 1865.

1507. W. Clark, Chancery Lane, "Improvements in the means of carburetting or treating aëriform fluids for lighting and heating purposes, and in apparatus for the same."—A communication from H. A. G. du Vergier, Boulevart St. Martin, Paris.—June 1, 1865.

1541. W. E. Newton, Chancery Lane, "An improved photo-electrotyping process."—A communication from W. A. Leggo, and G. E. Desberats, Quebec, Lower Canada.

1545. C. H. Wansbrough, Shrewton, Wiltshire, "Improvements in the treatment of condensing pans employed in the condensation of milk."—A communication from S. Percy, New York. U.S.A.—June 5, 1865.

1547. D. Barker, Ceylon Street, Battersea Park, "Improvements in the manufacture of artificial fuel."

1549. R. A. Brooman, Fleet Street, "Improvements in the construction of reservoirs for containing and storing petroleum and other oils."—A communication from P. Jacovenco, Bucharest, Wallachia.—June 6, 1865.

Notices to Proceed.

246. G. Haseltine, Southampton Buildings, Chancery Lane, "An improved process of manufacturing syrups and sugar from maize starch and other cereal grain starch."—A communication from F. W. Goessling, Buffalo, N.Y., U.S.A.—Jan. 28, 1865.

261. W. Teall, Wakefield, Yorkshire, and A. Naylor, Bradford, Yorkshire, "Improvements in means or apparatus for extracting or expressing oil or grease from the greasy waste of fibrous substances, or other substances containing oil or grease."—Jan. 30, 1865.

270. W. H. Cox, Bermondsey, Surrey, "Improvements in tanning hides and skins, and in apparatus employed therein."—Jan. 31, 1865.

310. J. A. Phillips, Kensington, "Improvements in the purification of lead to be employed for the manufacture of white lead, red lead, and litharge."

313. E. Hottin, Rue de la Fidélité, Paris, "Certain improvements in rendering uninflammable cotton, silk, and other textile fabrics."—Feb. 4, 1865.

447. W. E. Newton, Chancery Lane, "Improvements in apparatus for distilling petroleum and other volatile liquids and for making gas."—A communication from G. H. S. Dufflus, New York, U.S.A.—Feb. 16, 1865.

469. J. Graham, Warrington, Lancashire, "Improvements in treating products obtained when coating iron with zinc."—Feb. 18, 1865.

1287. W. Jackson, Glasgow, N.B., "An improved method of mixing gases and vapour, and in the machinery or apparatus connected therewith."—May 9, 1865.

297. T. Routledge, Sunderland, "Improvements in treating spent or used leys resulting from the preparation of fibrous substances used in the manufacture of paper stock."—Petition recorded Feb. 2, 1865.

301. B. L. Mosely, Norfolk Street, Sheffield, "A new or improved tooth powder."—Feb. 3, 1865.

307. F. Row, Colchester, "Improvements in the manufacture of citric and tartaric acids, and in the manufacture and treatment of citrate and tartrate of lime and analogous basic compounds, and in apparatus employed therefor."

319. R. M. Allowly, Strand, "Improvements in treating or manufacturing peat for fuel, and in apparatus for the same."—Feb. 4. 1865.

391. W. Crookes, F.R.S., Wine Office Court, Fleet Street, "Improvements in extracting and separating gold and silver from their ores or matrices."—Feb. 11, 1865.

893. W. M. Fuller, Wolverhampton, "An improved process for reducing or preparing waste animal matters for the purpose of employing the same in the preparation of manures or fertilising compounds."—March 29, 1865.

1319. H. Ransford, Brompton, Middlesex, "Improvements in treating rice and other grain for the manufacture of starch, also to prepare them for use as food, and for other purposes."—May 12, 1865.

CORRESPONDENCE.

Continental Science.

Paris, June 20.

You will probably have seen before now M. E. Kopp's admirable translation of your report of the farewell banquet to Dr. Hofmann in the *Moniteur Scientifique*, but I cannot help alluding to the introductory remarks, in which M. Kopp shows a gratifying appreciation of the position of foreign professors in England. "It," the banquet, he says, "shows that the *savants* of England, far from being led by mean jealousies (as is too often the case on the Continent), find a satisfaction and a pleasure in recognising and proclaiming the merit of their illustrious *confrère*, and that his old pupils retain a lively gratitude and sincere affection for the eminent professor who guided them in their early labours." This is perfectly true, and will be read with satisfaction both by Dr. Hofmann's entertainers and Dr. Hofmann himself.

In imitation of that entertainment, the *Moniteur* suggests a banquet to M. Chevreul, who will enter his eightieth year on the 1st of next September, and for fifty-five years, it is said, has stood the most faithful champion of French science. Some difficulties—jealousies,—however, will, I fear, have to be got over before this banquet takes place.

I find nothing in the report of the last meeting of the Société d'Encouragement worthy of notice, but the mention of an apparatus, contrived by M. Storms, which allows plants to water themselves when they stand in need of it. No description of this desirable apparatus is given, I am sorry to say.

I see the mention of a new combustible, invented by a gentleman who very appropriately bears the name of Stoker. It appears to be very pure charcoal, finely ground and made into a paste with starch. The paste is moulded into cakes or balls of different sizes, and then dried. When perfectly dry these may be lighted with a lucifer match, and will continue to burn steadily, like German tinder, without giving flame or smoke. The combustible is intended for heating urns, chafferettes, &c.

M. Dufour, of Lausanne, has made some experiments to ascertain whether other gases behaved like atmospheric air in the phenomenon of ebullition under different pressures. He employed hydrogen, carbonic acid, and coal gas, and found that when water saturated with either of these gases was heated to boiling in an atmosphere of the same gas, the phenomenon proceeded exactly as if the liquid were in the presence of air. The ebullition showed nothing unusual, and the temperature at which it took place was only raised one or two degrees. He concludes that the difficulty gases have in quitting liquids holding them in solution comes of a purely physical adhesion, and not of a chemical affinity.

Let us hope that the day is soon coming when that fatal disease, pulmonary consumption, will altogether disappear, since the remedies are now numerous enough. M. Fuster, who is a professor in the Faculty of Sciences at Montpelier—a school of renown in the annals of medicine—has discovered a specific. It is a very simple remedy—merely pills of raw beef and mutton, washed down by a not unpleasant form of grog—100 grammes of alcohol, 250 grammes of water, and 60 grammes of orange flower-water. There can be no objection to a little sugar in this latter mixture, I imagine.

The Dawlish Poisoning Case.

To the Editor of the Chemical News.

Sir,—There having been a great deal said, in your late numbers, respecting the above mysterious case, in which the arsenic is said not to have caused the death of Mrs. Williams, but that strychnia was the cause, I have (for the information of those interested) extracted the following from the *Atlas* for October, 1843:—"On the Different Effects of Arsenic on Different Persons.—In October, 1843, Mr. Wakley, M.P., held an inquest on the body of a person suspected to have been poisoned by arsenic. The coroner observed how extraordinary it was that arsenic should have an entirely different action on two different persons. Two persons shall have taken the same quantity of this poison. On the one it shall act just like an anodyne, soporifically, first producing somnolency, and finally death without pain or struggle. In the other, after it had been taken into the stomach, it shall produce violent vomiting and extreme agony, which shall continue until death takes place in the midst of excruciating torture. In the first instance, after death, dissecting will show no internal ulceration. In the second, it will produce marked appearances of the most violent inflammatory action. He (the coroner) was constantly struck with surprise at seeing in cases where the precise cause of death was surely known, the post-mortem appearances disagreeing *in toto* from what they ought to be, considering the cause of death."

I think, Sir, the symptoms of this second case are nearly identical with those of Mrs. Williams, so that the arsenic found in the stomach might have produced all her symptoms had strychnia not been present.

I am, &c. Jeremias.

Red Lion Street, Clerkenwell, June 20.

MISCELLANEOUS.

Royal Institution.—The following are the arrangements for the ensuing week:—Wednesday, June 28, at 4 o'clock, Thursday, June 29, at 4 o'clock, and Friday, June 30, at 4 o'clock, M. Jules Simon "On the Physical and Moral Condition of Workmen in France." (In French.)

Mode of Coating Copper with Antimony.—Dullo dissolves two ounces of butter of antimony in a quart of spirits of wine, and adds hydrochloric acid until the solution is clear. Into this solution he puts the object to be coated, previously well cleaned and polished. In the course of three-quarters of an hour a solid and brilliant covering of antimony is deposited. Cast iron may be coated with copper by placing it in an alkaline solution of chloride of copper, and then covered with antimony by the above process.—*Chem. Cent. Blatt.*, 1865, p. 368.

Phenic Vinegar.—Dr. Quesneville gives the following recipe for an *antipestilentiel.* Take acetic acid (5°), 900 grammes; camphor in powder, 5 grammes; crystallised phenic acid, 100 grammes. This combination of three antiputrescents is said to be extremely useful, and for hygienic purposes far superior to *vinegar of the four thieves*, as toilet vinegar was once called. It has been used a good deal on board ship to keep the cabins of sick persons sweet.—*Moniteur Scientifique*, 1865, p. 515.

Preparation of Bisulphide of Tin.—Kletinsky dissolves four parts of salt of tin in twenty parts of water previously mixed with two parts of strong hydrochloric, or one part of strong sulphuric acid. This solution is heated nearly to boiling, and then saturated with sulphurous acid gas. The following reaction takes place:—$3SnCl + 2HO + SO_3,HO + 5SO_2 = SnS_2 + 2(SnO_2,2SO_3) + 3HCl$. The yellow sulphide of tin is collected on a filter, washed and dried, and the filtrate may be distilled to recover the hydrochloric acid, sulphate of tin remaining in the retort. If the dried sulphide of tin is sublimed at a red heat, access of air being prevented, beautiful mosaic gold is obtained in large shining scales, and spangles of a brilliancy that is never seen with the old way of making the gold.—*Chem. Cent. Blatt*, 1865, p. 368.

Preparation of Gold Purple for Gilding.—Brescius states that gold may be easily obtained in this convenient form by precipitation in the cold from an alkaline solution by means of oxalic acid. He dissolves four ounces of gold in a mixture of two pounds nitric acid (sp. gr. 1·2) and one pound hydrochloric acid (sp. gr. 1·12). To this solution he adds another, made by dissolving pure potash, or, at all events, potash free from silica, in five or six parts of distilled water. After filtration, this latter solution is gradually added to the gold solution. The mixture is now diluted with eight pounds of distilled water, and then a clear and cold solution of one-third of a pound of oxalic acid is stirred in, care being taken not to rub the sides of the dish with the rod. In this way a bulky, spongy, black precipitate is obtained, which must be allowed to settle, and then be well washed and dried.—*Dingler's Polytech. Journal*, Feb., 1865, p. 217.

ANSWERS TO CORRESPONDENTS.

⁂ In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. X. of the Chemical News, containing a copious Index, is now ready, price 11s. 0d., by post, 11s. 6d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. XI. commenced on January 6, 1865, and will be complete in 26 numbers.

⁂ All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. *Private* letters for the Editor must be so marked.

Received.—Dr. Hassall.

R. S.—Dr. Letheby's lecture will be published in an early number.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

The Molecular Weight of Protochloride of Mercury, by M. E. ERLENMEYER.*

SOME chemists attribute to protochloride of mercury the formula $\text{Ħg}\text{Cl}$, others $\text{Ħg}_2\text{Cl}_2$; in seeking for a solution of this question the author made the following experiment:—Into a flask with a long, difficultly fusible glass neck, he introduced a tube three times the length of the neck. This tube, closed at one end, penetrated to the centre of the matrass, and was filled with mercury to the height of two inches and a quarter. Some protochloride of mercury was heated in the flask for half an hour, at a temperature high enough to make the mercury boil and the vapour condense only two inches and a quarter above the level of the liquid. After cooling, globules of mercury were observed on the outside of the tube and in the neck of the flask, and both were carefully cleaned to remove all the metallic mercury. They were then heated a second time until the flask became perfectly transparent, and no volatile product remained condensed. The apparatus was then slowly cooled, and a deposit of mercury larger than the first was found; the united metallic globules formed 0·0296 grm. Crystals were deposited at the beginning of the neck of the matrass, which were crushed in a mortar, then shaken for some time in cold water, and were found to contain bichloride of mercury.

This experiment, says the author, does not prove that the composition of chloride of mercury is $\text{Ħg}_2\text{Cl}_2$; the formula $\text{Ħg}\text{Cl}$ might with equal justice be attributed to it, for $\text{Ħg}\text{Cl} + \text{Ħg}\text{Cl}$ would give $\text{Ħg} + \text{Ħg}\text{Cl}_2$; the experiment does not in any way show that all the vapour which gives the protochloride of mercury is $\text{Ħg} + \text{HgCl}_2$. Were it proved that solid protochloride is $\text{Ħg}_2\text{Cl}_2$, it might very well be that the vapour might be composed of $\text{Ħg}\text{Cl} + \text{Ħg}\text{Cl}$ and $\text{Ħg} + \text{Ħg}\text{Cl}_2$; to prove that the protochloride vapour is really $\text{Ħg}_2\text{Cl}_2$, it would be necessary to obtain half the vapour in the form of metallic mercury, and half as bichloride.†

TECHNICAL CHEMISTRY.

Detection of the Adulteration of Essential Oils with Oil of Turpentine by the Saccharimeter, by Dr. JULIUS MAIER, *Assistant in the School of Mines, Columbia College, N. Y.*

THE essential oils, especially the expensive ones, are mostly adulterated with oil of turpentine. It is often difficult to detect this adulteration, especially when the adulterated oil gives similar reactions with oil of turpentine.

With the saccharimeter it is possible not only to detect the adulteration, but even to find out the quantity of oil of turpentine mixed with the other essential oils. A large number of oils, particularly those belonging to the camphenes, the carbon of which is in the proportion of 5 to 8 to their hydrogen, have an action on the polarised light, deviating the light either to the right or the left hand side. These optical researches have been made by Biot, Soubeiran, Capitaine, Gladstone, and Berthelot, in order to establish the constitution of the camphenes. I made some researches to detect the adulteration of the essential oil with the oil of turpentine.

For that purpose, a chemically pure oil of lemon, which I had prepared myself, was tested in a saccharimeter, the tube of which was 200 mm. long.

The deviation was +137°·296 for the middle yellow ray. The oil of turpentine used for the research, prepared by myself, had a specific gravity of 0·865, and gave a deviation of −73°·135. A mixture of equal volumes of both these oils showed a deviation of +30°·65. The calculation gives a deviation of +32°·081 in the following manner:—

½ vol. oil of lemon = + 68·648
½ vol. oil of turpentine = − 36·567

1 vol. mixture = + 32°·081

A mixture of 2 vol. oil of lemon with 1 vol. oil of turpentine gave a deviation of +65°·34; from the calculation results a deviation of +67°·152, as follows:—

⅔ vol. oil of lemon = +91°·531
⅓ vol. oil of turpentine = −24°·379

1 vol. mixture = +67°·152

I made the same researches with pure oil of juniper, which I had prepared myself, and arrived at the following results:—

The oil used for the experiment had a specific gravity of 0·858, and showed a deviation of −5°·970. The oil of turpentine employed was the same as in the above-mentioned experiment. A mixture of equal volumes of oil of juniper and oil of turpentine showed a deviation of −40°·84; the calculation gives a deviation of −39°·553, as follows:—

½ vol. oil of juniper = − 2°·985
½ vol. oil turpentine = − 36°·568

1 vol. mixture = − 39°·553

From this it is proved that the quantity of the adulterating oil of turpentine can be detected through the medium of the saccharimeter. But if the essential oil is adulterated not only with oil of turpentine but also with another optically active oil, the saccharimeter test is of no value. In order to find out the quantity of the adulterating oil of turpentine from the deviation showed by the oil of turpentine, by the adulterated oil, and by the mixture, the numbers of deviation have to be brought in reference to a common distinct starting point. This starting point generally is the power of rotation—that is, the deviation of the respective oil as calculated for a tube of 100 mm. length, and a specific gravity of 1. This power of rotation, the worth of which is generally expressed by [α], is the following for:—

Oil of turpentine [α] = −42°·275
Oil of lemon [α] = +80°·573
Oil of juniper [α] = + 3°·479

The quantity of oil of turpentine employed for the adulteration is calculated as follows:—

a the power of rotation of the pure oil.
b " " " " oil of turpentine.
c " " " " mixture.
m the quantity " "
x " " adulterating oil of turpentine.

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* *Annalen der Chemie und Pharmacie*, cxxxi., 124.

† Dr. Odling (see *Journal* of the Chemical Society, ii., 211) explains the irregularity of the density of protochloride of mercury vapour by admitting that $\text{Ħg}_2\text{Cl}_2$ in the state of vapour splits up into one atom of mercury and one molecule of bichloride of mercury; he supports this opinion by the fact observed by himself, that gold leaf becomes covered with mercury in the vapour of calomel, and that bichloride is formed at the same time. M. Erlenmeyer attributes this reaction to the affinity of mercury for gold, and sees no other cause for this decomposition.

The quantity of the pure oil as contained in the mixture is $=m-a$, and the power of rotation of this quantity is $=(m-x)a$; the power of rotation of the oil of turpentine $=-bx$, and the power of rotation of the whole quantity of mixture $=mc$; hence results the following equation:—

$$(m-x)a-bx=mc$$
$$ma-ax-bx=mc$$
$$ma-mc=ax+bx$$
$$\frac{m(a-c)}{a+b}=x$$

To show this calculation by an example, the power of rotation is supposed to be—

of the pure oil of lemon = + 80°·573
" " " turpentine = − 40°·275
" mixture = + 18°·70
the quantity of the mixture = 20 c. cm.

$$(20-x)80{\cdot}573-40{\cdot}275x=20\times18{\cdot}70$$
$$7611{\cdot}46-80{\cdot}573x-70{\cdot}275x=374$$
$$1237{\cdot}46=122{\cdot}848x$$
$$10{\cdot}0=x.$$

The mixture contains equal parts of the pure oil and the adulterating oil of turpentine.

Optical Behaviour of Several Essential Oils.

Tested Oil.	Specific gravity.	Power of rotation.	Observer.
Oil of absinth . . .	0·973	+ 20°·67	Soubeiran and Capitaine.
Oil of orange blossoms, first product . .	0·835	+127°·43	
Oil of orange blossoms, second product . .	0·837	+125°·59	
Oil of bergamot . .	6·850(?)	+ 29°·28	Biot.
Oil of bergamot, first product . . .	0·850	+ 49°·396	Soubeiran and Capitaine.
Oil of bergamot, last product . . .	0·877	− 6°·573	
Oil of carraway seed .	0·897	− 11°·7	Maier.
Oil of lemon . . .	0·848	+ 80°·484	Biot.
Oil of lemon . . .	0·852	+ 80°·573	Maier.
Oil of lemon (Grasse), first product . .	0·844	+ 79°·749	Soubeiran and Capitaine.
Oil of lemon (Grasse), last product. . .	0·853	+ 78°·156	
Oil of lemon, rectified .	0·854	+ 80°·916	
Oil of copaiva balsam .	0·881	− 34°·18	
Oil of copaiva balsam (Para)	0·898	− 28°·553	
Oil of cubebs . . .	0·929	− 40°·159	
Oil of cubebs, free from water	0·914	− 39°·40	
Oil of elemi . . .	0·852	− 90°·30	Deville.
Oil of juniper . . .	0·855	− 3°·521	Soubeiran & Capitaine.
Oil of juniper . . .	0·858	− 3°·479	Maier.
Oil of turpentine . .	0·8712(?)	− 39°·950	Biot.
Oil of turpentine . .	0·860	− 43°·38	Soubeiran & Capitaine.
Oil of turpentine . .	0·865	− 42°·25	Maier.

Gladstone (Chem. Soc. *Jour.*, [2], ii., 1) has given a more complete table on the power of rotation of most of the essential oils. My researches were restricted to the few above mentioned.—*American Jour. Science*, xxxix., 273.

Improvements in the Manufacture of Sugar.

A correspondent writes:—"I have seen some sugar from Antigua which is the result of a new mode of boiling down. This sugar is in reality only boiled-down juice, and yet it is so dry that after being carried in paper in the hold of a ship some weeks, only a few moist spots are observable. This every one knows is possible only with very dry sugar. The colour is light grey, or better than colonial sugar from which the treacle is extracted. In other words, this is sugar manufactured without molasses or treacle being formed. Now, if we take the amount of loss from crystallisable sugar being made into treacle at 20 per cent., this increase in the amount of sugar will at once be given to our colonies, if this method is practicable. It is equal to increasing them by nearly one-third without trouble or expense.

"We learn from Antigua papers that Mr. Alfred Fryer, of Manchester, has been making the first trial in that colony, where the firm, Messrs. Fryer, Benson, and Forster, have bought sugar estates for the express purpose of beginning the new system.

"It is well known that when the juice of the cane is boiled down the amount of uncrystallisable matter increases. The increase may be said to be 14 or 15 per cent. but an equal amount of sugar is thereby rendered uncrystallisable, so that about 30 per cent. is actually lost to the consumer.

"Mr. Fryer found that cane juice containing 2·6 per cent. of fructose or uncrystallisable sugar, after being heated in a closed vessel for an hour without air at 250° Fahr., contained 55 per cent. of fructose. Juice which contained 13·1 per cent. by boiling for an hour at 215° F. was found to have 29·5 per cent. of fructose. The temperature reached in the colonies is about 242° F.

"After the juice had been boiled down into dry sugar by Mr. Fryer, and then dissolved in the same amount of water which it had lost, it actually contained as much crystallisable sugar as before. It is believed that no fructose whatever is passed, and other experiments made by Mr. Fryer seem to confirm this. He has found that the cane-juice is not entirely free from fructose, that on the contrary from 1·3 to 13 per cent. of the sugar exists in that state; it is impossible, therefore, to obtain boiled down sugar entirely crystallisable.

"The name given to this apparatus for rapid evaporation is 'the concretor,' as the sugar is obtained in a solid hard form, in which condition it is sent over to this country to be refined.

"The amount of acidity is equal only to that in the cane juice. The colour of the dissolved concrete is superior to that of the juice left after the first crystallisation in sugar works, and the sugar beetle, we believe, does not appear.

"No wonder that the Governor of Antigua should have said to Mr. Fryer, at a large public and enthusiastic meeting, 'I believe firmly that you have opened a new era of prosperity to our colonies, and heartily wish you abundant success in the course on which you have entered.'

"It seems true, and it is wonderful, that whilst we have been complaining so long in our sugar colonies, we, and the rest of the world, should have been spoiling one-third of our sugar. Mr. Fryer estimates the increased value of the produce treated by his system to be equal to 4*l.* per hogshead. We need not give a description of the evaporator, which consists of very shallow vessels connected in series and the use of heated air."

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, March 10.

"*On the Eozoon and the Laurentian Rocks of Canada.*"

By Professor A. C. Ramsay, F.R.S.

Mr. Ramsay commenced by giving a brief account of the physical structure of part of the interior of North America, which consists of great plains and table lands lying between the ranges of the Laurentian mountains (which run from Labrador far westward along the north shores of the St. Lawrence and Ottawa), the mountains of Gaspé and the Appalachian chain, and the gradual slopes of the Rocky mountains in the far west. The geological survey of Canada embraces great tracts of the Laurentian mountains and of the mountains of Gaspé, and all the flat country that lies south of the St. Lawrence, the Ottawa, and Lake Huron, and in these territories a vast region has been surveyed in a manner that may fairly be said not to have been surpassed on any part of the North American continent. This survey was begun in the year 1842, and before its commencement the Silurian strata of the United States having been generally correlated to those of Europe, the precise relations of the strata of Canada to both soon began to be established. Before that period very little was known by geologists about the Laurentian rocks, except that they consisted of gneiss, granite, syenite, and so-called igneous masses, and the geological age of the series was undetermined. Indeed, the gneiss of the mountains north of the St. Lawrence, and of the Appalachian chain, of Gaspé, Newfoundland, and other districts were all more or less confounded together, and supposed, as gneiss, to be probably of the same or nearly of the same age.

But in 1845 it was first proved by Sir William Logan that the Laurentian gneiss lies unconformably under the Potsdam sandstone, a rock well known to be the equivalent of the Lingula flags of Britain, or the "Primordial zone" of Barrande, then and for long after supposed to contain in its lingulæ and trilobites the earliest created forms of organic life. This, taken in connection with the discoveries of other American geologists, clearly proved the Laurentian gneiss to be of much earlier date than the greater part of the gneiss of the Green Mountains (a part of the Appalachian chain), and of Gaspé, &c., for they were shown to be the metamorphosed representatives of various members of the Silurian series, most of them younger than the Potsdam sandstone.

This was followed by the discovery of the Huronian rocks, which were proved also to be older than the Potsdam sandstone, but younger than the Laurentian gneiss; and not only so, but it was shown that the Huronian rocks, themselves metamorphic, were deposited after the metamorphism of the Laurentian strata; for they contain pebbles and boulders of the latter in such a condition, that it is plain the metamorphism of the masses from which they were derived took place long before the commencement of the Huronian epoch.

In 1863 a stratigraphical discovery, still more remarkable, was made; for it was proved that the Laurentian rocks themselves consist of two series of altered strata, the uppermost of which lies in the highest degree unconformably on the lower series; and it was again found that the Potsdam sandstone, quite unaltered, lies thoroughly unconformably on the upper Laurentian gneiss.

Besides total unconformity, there is a marked and constant distinction in the nature of the gneiss of the two series, the lower being Orthoclase-gneiss, containing potash-felspar, while the upper has been called Anorthosite-gneiss, containing lime and soda-felspar, much of which is true Labradorite; and these differences being constant, there is no difficulty in distinguishing the two series.

Both series are exceedingly contorted, and have undergone an amount of metamorphism that may almost be called extreme, unless we adopt the view that granite and its allies are the result of an amount of metamorphic action so excessive that the rocks have passed beyond the stage in which foliation still remains.

The Lower Laurentian being at present the oldest known stratified series, its base is unknown; although as it contains in some cases *water-worn stratified pebbles*, it is clear that its original unmetamorphosed materials were derived from the waste of consolidated stratified formations of far older date. Neither are its topmost strata known, for all the other strata with which it is in contact lie unconformably upon it. Its known thickness is, notwithstanding, very great, as the following measured section of a portion of the strata will indicate. It is given in descending order:—

1	Orthoclase gneiss	3400 feet.
	Crystalline limestone.	20 „
	Orthoclase gneiss	1580 „
2	Crystalline limestone of Grenville, with a thin band of gneiss and *Eozoon Canadense*	750 „
	Orthoclase gneiss, with quartzite and garnets	3500 „
3	Crystalline limestone, with two bands of gneiss, with garnets and hornblende	2500 „
	Orthoclase gneiss	4000 „
4	Crystalline limestone of Trembling lake	1500 „
	Orthoclase gneiss of Trembling mountain.	5000 „
		22,250 „

It was in 1858 that fossils were found in the band of limestone No. 2; and at first they were considered by Sir Wm. Logan to belong, probably, to the genus of corals known as *Stromatopora*, but renewed examinations, first by Dr. Dawson, Principal of McGill College, Montreal, and afterwards by Dr. Carpenter, establish that in reality the fossils are *Foraminifera*, not detached like those of more modern type, but that they lived and grew in a peculiar mode over wide areas in the sea bottom, in a manner somewhat analogous to the mode of growth of a bank of corals. The chambers (as shown in the diagrams used) are unsymmetrical, and while growing spread irregularly, and they are enclosed above and below by a layer having a finely tubular structure similar to that of the shell of the nummulite and other allied forms. Between these layers the sarcode-body was enclosed, and between the irregular chambers there frequently lies an inter-skeleton, penetrated by numerous branching tubes, and by an occasional larger tube, called by Dr. Carpenter the stolon. The chambers that contained the sarcode-body and the tubes now consist of serpentine, and the inter-skeleton of carbonate of lime; and on an acid being applied the silicious casts of the tubes are found so arranged that Dr. Dawson and Dr. Carpenter had no doubt as to the organic nature of the specimens, which were examined by them with the microscope most carefully. Better authority it is impossible to have.

Having visited the district with Sir Wm. Logan, I think I may safely say that the chief part of all the bands of limestone is so crystalline (from metamorphic action) that it is hopeless to expect to find fossils in them; but that part of the band No. 2, in which they have heretofore been observed, attains a thickness of about 200 feet, and doubtless Eozoon or other traces of organic remains may yet be found elsewhere. It is by a lucky accident, so to speak, in metamorphic action, that they have been preserved where we now find them, and, said the speaker, "I for one firmly believe not only that all these Laurentian deposits were of marine origin, but also that the original matter of limestones of such vast thickness, and that once spread so widely over that old sea bottom, must have been chiefly formed by the growth and decay of organic bodies."

Mr. Ramsay then showed the importance of these discoveries in relation to *geological time*.

First he spoke of metamorphism having, according to the best hypothesis, been produced by heated alkaline waters in rocks deeply buried beneath vast accumulations of strata, since removed by denudation.

Before the commencement of the Silurian epoch such metamorphic actions had already taken place three times: first, in the lower Laurentian rocks; secondly, in the upper Laurentian rocks; and thirdly, in the Huronian series, and each set of strata had evidently been subjected to prodigious waste and denudation, before the commencement of the formation that now succeeds it in the American series.

But secondly, geological time is not to be measured merely by the formations now existing, for the unconformities indicate gaps, or periods of time, stratigraphically unrepresented, which were probably far longer in duration than the time occupied in the deposition of the formations that remain.*

Again, an instructive moral may be drawn from a consideration of the subject with regard to the style of reasoning that has often been too prevalent with respect to the discovery of the oldest zones of life of various kinds. For example, for many years no one doubted that the lower tertiary or eocene beds contained the oldest relics of mammalian life, and a great outcry of disbelief was raised when they were discovered in the secondary rocks in the Stonesfield slate of the lower Oolite. Since then the *Microlestes* has been found in the new red series, and there for the time it rests. The same kind of astonishment prevailed as reptile bones were successively discovered down through the Lias into the Trias, and from these into the Palæozoic formations of permian, carboniferous, and old red sandstone age. And when we consider the history of the mollusca, as recorded by distinguished geologists, the same hankering after finality has constantly cropped out. The "primary formations," it was said, contained no fossils, for they were formed before the creation of life began: till late in last century Hutton dispelled the illusion by proving the presence of fossil shells in so-called "primary clay-slates." For some time the Llandeilo flags of Sir Roderick Murchison were regarded as the oldest fossiliferous rocks, till on the discovery of the still older lingula flags and their equivalents in Bohemia, they were fondly named the *primordial zone*. "Here at last is a resting place: we can hope for nothing older than the lingulæ and trilobites of this great original 'primordial zone;' but soon Mr. Salter found annelids, and, as he thinks, trilobites on a horizon lower still, and the beginning was again thrown farther back into time; and no one dared to dream of traces of life yet older being found in gneiss, for if they even ever existed there, which is improbable, they must have been all obliterated by metamorphic action. Suddenly Sir W. Logan makes a great leap, thousands of fathoms deeper than any formation previously known to contain the relics of life, and from the limestones there extracts the Eozoon, from rocks so immeasurably older than the oldest Silurian and Cambrian strata, that no power of imagination can feebly realise, even in a geological sense, the great gaps that lie between them; and though we may feebly attempt to estimate the latest lapses of geological time, we can no more hope to fathom these Laurentian depths than we can hope to measure the distance of the most unresolvable of the unresolved nebulæ, merely because we are able to estimate our distance from the sun."

NOTICES OF PATENTS.

1913. *Manufacture of Green Colouring Matters to be Used in Dyeing and Printing.* H. Carter, Camberwell New Road. Dated August 1, 1864.

1949. *Producing Colour from Aniline.* A. H. A. Pilughaupt, Manchester. Dated August 4, 1864. (Not proceeded with.)

In the first of these patents the object of the inventor is to produce a green colouring matter by the action of copper or iron salts, or mixtures of these, upon suitable compounds of aniline, toluidine, or homologous bases. The product thus obtained may be employed alone for dyeing or printing, or the tint may be modified by admixture of soluble blue or purple colour.

According to the second specification, it is proposed to effect the conversion of neutral aniline salts (of commercial quality, and, therefore, containing toluidine) into magenta dye or other compounds of rosaniline by the action of atmospheric oxygen at an elevated temperature. The inventor employs a basic compound in admixture with the aniline salt for the purpose of absorbing the free acid commonly liberated during the conversion of aniline into rosaniline; and he states that his mode of production possesses the advantage of economy, inasmuch as none of the aniline distils over, and a subsequent treatment is thereby avoided.

1937. *Making Non-Inflammable Plain and Twilled Dyed Cotton Fabrics, &c.* B. O'Conner, Manchester. Dated August 4, 1864.

1957. *Rendering Uninflammable Cotton, Silk, &c.* E. Hottin, Paris. Dated August 6, 1864. (Not proceeded with.)

For the purpose of rendering cotton and other textile fabrics uninflammable Mr. O'Conner passes the goods through a solution of one part of chloride of magnesium in four parts of water, or immerses them in the liquid until they have become thoroughly saturated. The pieces are then removed, dried, and finished in the usual manner. The patentee claims the employment of other salts of magnesium for the same purpose, and lays stress upon the use of a small proportion of the bromide, not exceeding ten per cent., in conjunction with the chloride.

M. Hottin effects the same purpose by the old method of treatment with an aqueous solution of phosphate of ammonia, and gives directions for its preparation by adding ammonia to aqueous biphosphate of calcium, and digesting the filtered solution with precipitated silica. The goods are dressed in the usual manner, with starch, gum, or dextrine.

The deliquescent character of the salts recommended to be used in the above specifications must be very detrimental to their employment; and if, on the other hand, a crystallisable salt be selected, such as the sulphate of magnesia included in the claim of Mr. O'Conner, it is well known that a certain degree of rottenness by disintegration of the fibre is the result.

1941. *Coatings for the Prevention of the Fouling of the Bottoms of Iron and other Ships.* F. Cruickshank, Edinburgh. Dated August 4, 1864.

1962. *Compositions for Preventing the Bottoms of Iron Ships from Fouling or Corroding.* C. Bartley, Blackheath. Dated August 6, 1864.

These patents both refer to the employment of mercurial preparations, with or without white lead paint, for the purpose of preventing the attachment of sea plants and animals, and overcoming the corrosion of ships' bottoms. The first specially claims the use of red oxide of mercury, white precipitate of the British Pharmacopœia, or any one of the various combinations of corrosive sublimate with oxide of mercury to which the name of "oxychloride of mercury" may be applied. These several materials are rendered applicable for the purpose by being incorporated with resinous or oleaginous media, and are then laid on the iron, or other metallic surfaces, like paints.

The second specification describes the use of corrosive sublimate conjointly with white lead. The mercury salt is dissolved in methylated spirit, and incorporated with the lead paint in the following proportions:—

White lead paint	1 cwt.
Corrosive sublimate . . .	6 lbs.
Powdered gum arabic . . .	6 ,,
Castor oil	6 ,,

---

* See the Presidential Anniversary Addresses to the Geological Society for the years 1863 and 1864, by Professor A. C. Ramsay.

It is recommended to apply this material as a second coating upon one of pure white lead paint, and then to lay on a third coating similar to the second, but with the addition of three pounds of verdigris and two pounds more of corrosive sublimate (*i.e.*, eight pounds instead of six), mixed with one gallon of whale oil and the other materials already indicated.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

1515. H. Allman, Ampthill Square, Middlesex, "Certain improvements in the means employed for the prevention of the ignition of matter capable of ignition or combustion."—Petition recorded June 2, 1865.

1535. P. Coombes, Liverpool, "An improved apparatus for separating the whey from the curd in the manufacture of cheese."—June 5, 1865.

1553. J. Howarth, M.D., Andover, Mass., U.S.A., "An improved method for distilling coal, shale, and other carbonaceous substances."—A communication from J. Howarth, Salem, U.S.A.

1554. A. C. Henderson, Charing Cross, "Improvements in tanning hides, and in apparatus connected therewith."—A communication from E. S. Beaux and E. Pannifex, Paris.

1559. W. Sim and A. Barff, Glasgow, N.B., "An improved method of generating heat, and in the apparatus or means for effecting the same."

1560. J. Ferguson and R. Miller, Glasgow, N.B., "Improvements in the manufacture of steel."—June 7, 1865.

Notices to Proceed.

366. J. G. C. Halkett, Cramond Iron Works, County of Mid Lothian, N.B., "Improvements in protecting wooden surfaces from the fouling and injury to which they are ordinarily liable in sea water."

371. J. Dale, Manchester, "Improvements in the production of substances to be used in place of the pigment usually termed satin white."—Petitions recorded Feb. 9, 1865.

388. J. Hall, Nottingham, "The manufacture or production of oil for the use of machinery, or for other similar purposes."—Feb. 11, 1865.

403. J. A. Pastorelly, Rue Curiol, Marseilles, "Improvements in extracting turpentine and tar from resinous wood."

408. E. J. C. Welch, Harrow, Middlesex, "Improved apparatus for supplying, with a constant and regular pressure, air to burners for consuming or burning hydrocarbons for illuminating purposes."—Feb. 13, 1865.

419. E. H. Newby, Cheapside, "Improvements in the manufacture of cast and wrought iron."—A communication from A. L. Fleury, New York, U.S.A.—Feb. 14, 1865.

449. F. A. Laurent, J. Casthelaz, and N. Basset, Rue St. Croix de la Bretonnerie, Paris, "Improvements in the manufacture of oxalic acid."—Feb. 16, 1865.

470. W. Robinson, Watling Street, London, "Improvements in the manufacture of iron and in articles made thereof."—Feb. 18, 1865.

478. J. Cliff, Wortley, near Leeds, "An improvement in the utilisation of the waste gases of blast furnaces."—Feb. 20, 1865.

666. J. Cliff, Wortley, near Leeds, "An improvement in the construction of hot-air stoves for blast furnaces."—March 9, 1865.

945. J. R. Wigham, Monkstown, County Dublin, "Improvements in the means and apparatus employed for illuminating lighthouses."—April 4, 1865.

CORRESPONDENCE.

On the Red Hematites of Waldeck.

To the Editor of the Chemical News.

Sir,—I have been lately exploring the iron, copper, and lead districts of the principality of Waldeck, and wish to call your attention to some peculiarity presented by the red hematites of that district. Red hematite is very abundant in Waldeck and Hesse, though not often near the surface; it is always mixed with a notable proportion of magnetic oxide of iron, and in some places passes into a peculiar crystalline mineral, containing upwards of 20 per cent. of magnetic oxide, though still retaining the crystalline form of peroxide of iron. Some of these ores have been already analysed in my laboratory in London, and on my return to England I will, with your permission, forward to the Chemical News the details of their composition.—I am, &c. T. L. Phipson, Ph.D., F.C.S., &c.

Frankfurt, A. M., June 20.

MISCELLANEOUS.

Death of Professor Reveil.—Dr. Réveil was one of the most promising scientific chemists of Paris, attached as assistant professor both to the Faculty of Medicine and the School of Pharmacy. He died suddenly at a nursery garden in Versailles, where he was ordering flowers for a family party, at the age of 44. The deceased may be said to have died of overwork, as the public and courts of law placed the most implicit confidence in him as an analytical chemist. Dr. Réveil obtained all his appointments by competition, and was an indefatigable labourer in the branch of science he had chosen. He published many works, and quite lately a translation of Mr. Piesse's book on perfumes.—*Lancet.*

Important Invention.—The *Western Morning News* states that Mr. Gale, electrician, of Plymouth, has discovered a process by which powder can be rendered non-explosive, and its properties restored when required. The process is simple and effective, and cannot injure the powder. The cost is very small, and it has the advantage of being readily applied. In five minutes a barrel of powder can be made non-explosive, and in another five minutes it can be restored to its original condition. The invention will solve the difficulty which has been felt as to the storage of powder in time of peace, and in war it will avert the danger which now arises from the necessity of fighting in the neighbourhood of an explosive material.

Estimation of Carbon in Cast-iron.—Weyl connects the iron with the positive pole of a Bunsen's battery, and immerses it in hydrochloric acid with a platinum plate for negative pole. This method is recommended by Fresenius, and has been employed by Kinmann for Bessemer steel, in which he found 0.65 per cent. of carbon.—*Chem. Cent. Blatt*, 1865, p. 368.

ANSWERS TO CORRESPONDENTS.

J. R.—1. Yes. 2. We think not.

P. Scott.—It should be acid.

F.R.S.—The answer to your query would be too long for insertion here; we have therefore left it for you at the Chemical News Office, addressed to you in your private name.

A Tyro.—We are always happy to be of every possible use to our subscribers, but we really cannot be expected to answer questions the solutions to which may be found in every chemical handbook.

Received with Thanks.—R. V. Tuson; Geo. Jones, F.C.S.; C. M. Warren.

Books Received.—"On the Composition of the Atmosphere," by Dr. R. Angus Smith, F.R.S. "Braithwaite's Retrospect of Medicine." January to June, 1865. "The Sewage Committee of 1864," by Thos. Spencer, F.C.S. (pamphlet).

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THE

CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE:

WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE.")

A Journal of Practical Chemistry

IN ALL ITS APPLICATIONS TO

PHARMACY, ARTS, AND MANUFACTURES.

EDITED BY

WILLIAM CROOKES, F.R.S.

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THE CHEMICAL NEWS.

VOLUME XII.

No. 292. July 7, 1865.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On Chemical Nomenclature. By Alexander W. Williamson, *F.R.S., F.C.S.*

I had some weeks ago the honour of submitting to the consideration of the Chemical Society a few practical suggestions on the subject of chemical nomenclature, framed in the hope of diminishing the inconsistencies which prevail in it at present, and of aiding the development of its best tendencies.

My chief proposal was to adopt, as systematically as possible, terms such as mercurous nitrate, $Hg_2(NO_3)_2$; mercuric hydronitrate, $HgHONO_2$; hydric sulphate, H_2SO_4; potassic hydrate, KHO; hydropotassic sulphate, $HKSO_4$; hydrodisodic phosphate, HNa_2PO_4; sodic sulphate, Na_2SO_4; sodic disulphate, $Na_2S_2O_7$, &c.; ferric oxydisulphate, $Fe_2O(SO_4)_2$; ferric dioxysulphate, $Fe_2O_2SO_4$, &c. The result of two evenings' discussion of the subject was to show that the principles of such nomenclature are, upon the whole, approved, and the names formed in accordance with those principles offer altogether greater proportional recommendations than any other names which are before chemists.

In the course of the discussion which took place on the subject, I had occasion to point out that, inasmuch as salts in which the base is hydrogen, such as hydric nitrate, hydric sulphate, hydric phosphate, &c., are admitted to be analogous in their constitution and properties to the salts of the regular metals such as silver, potassium, &c., it is desirable, when describing their reactions, to designate them by names bearing a corresponding analogy to the names of the salts of silver, potassium, &c.; that in describing the reactions of double salts, containing as base partly hydrogen, partly some heavier metal, such as common rhombic phosphate, HNa_2PO_4, it is not only desirable to introduce the name of the hydrogen in a form similar to that of the other metal, but it is really not possible to obtain systematic and consistent names without representing in them the metallic functions of the hydrogen; that when hydrogen is in the place of an acid or chlorous constituent of a salt, it must be described by a term which represents the fact of its having such functions.

In fact it is not allowable to apply to hydrogen-salts names which conceal their analogy with other salts, or which imply the absence of saline constitution in hydrogen salts. Thus it is a faulty expression to say that the common process for preparing so-called nitric acid consists in the action of sulphuric acid on potassic nitrate, forming potassic bisulphate and nitric acid; for such an expression conveys the idea of a mere displacement of one acid by another, whereas the process is admitted to be an interchange of half the hydrogen in hydric sulphate with potassium in potassic nitrate, forming hydropotassic sulphate and hydric nitrate.

It was admitted by all who spoke on the subject at the Chemical Society, that hydrogen-salts must in exact language be named similarly to other salts; and one distinguished member mentioned that, in describing to students such a reaction as the above, he uses such terms as sulphate of hydrogen and nitrate of hydrogen.

It was at first supposed by some members that I advocated the immediate introduction of systematic and accurate names into common and popular language. The learned member felt alarm at the danger of having to speak of mercurous chloride instead of "calomel," manganic peroxide instead of "manganese," hydric sulphate instead of "sulphuric acid," &c.; and manufacturers would certainly not have received with favour a proposal to give up the term "soda" for sodic carbonate, to say arsenious acid instead of "arsenic."

I accordingly hastened to explain that my suggestions towards improving our systematic nomenclature were only expected, if adopted, to react gradually upon the popular language, and that for the present I contemplate ordering a couple of carboys of "sulphuric acid" or "nitric acid" as heretofore, meaning those compounds which in systematic language are designated "hydric sulphate" and "hydric nitrate;" but that when I have to explain to learners the reactions of those hydrogen salts, I should give them the systematic names which correspond to their composition. The popular and trivial names by which they are known are abbreviations formed so as to point to the essential or characteristic constituent. It is not practicable to send out real sulphuric acid, SO_3; but manufacturers and consumers know that the value of oil of vitriol is not in the water which it contains, but in the "real acid." In like manner, the common crystals of hydrated sodic carbonate are valuable in proportion to the percentage of soda, Na_2O, which they contain, and they are not unreasonably named after their characteristic constituent.

There was, on the part of one or two distinguished members of the Society, a feeling that the retention of the words acid and base in their established signification of "electro-negative oxides" and "electro-positive oxides" might be inconvenient in presence of the fact that chlorine forms with hydrogen a very acid salt, and that some other elements also form acid hydrides. But when it is admitted that H_2SO_4 is a salt, though of very acid properties, that HNO_3 and H_3PO_4 are also very acid salts, and that in scientific language they must be designated as salts, it really is not surprising that HCl, HBr, &c., should be salts of considerable acidity, and it is not unnatural to call them salts of hydrogen in systematic nomenclature. The fact that we cannot remove the elements of water from hydric chloride and make $Cl_2—O$, whilst we can remove water from hydric sulphate and make $SO_4—O$, is really no reason against classing, side by side, hydrogen salts with compound radicals such as NO_3, SO_4, PO_4, &c., and those with elementary radicals such as Cl, Br. &c.

Since my suggestions have been published, Mr. Foster has published in the *Philosophical Magazine* a paper "On Chemical Nomenclature, and chiefly on the use of the word Acid." In this paper Mr. Foster expresses assent to the form of names of which I had recommended the systematic adoption; and he says, "If we regard the salts of hydrogen as constituted like the salts of any other metal, the application to them of the name acid becomes incorrect if it implies any peculiarity of constitution, and superfluous if it does not." Now, as Laurent and Gerhardt did admit and assert that the salts of hydrogen are constituted like the salts of any other metal, and as Mr. Foster is doubtless perfectly aware that they did so, the above sentence is a distinct condemnation of Gerhardt's proposal of applying the word acid to salts with hydrogen as base. And coupled as it is with Mr. Foster's admission that these hydrogen salts ought, in systematic language, to be called hydric sulphate, hydric nitrate, &c., it does convey Mr. Foster's assent in a very full manner to the principle of the proposal which I made on the subject of nomenclature.

The general form of Mr. Foster's paper is, however, that of an argument against my proposal; and the paper contains some statements to which my silence would probably seem to give a consent which I really cannot give. It must have been from inadvertence that Mr. Foster speaks of my wishing to apply the name acid to such bodies as CO_2, SO_3, SiO_2, &c.; for I merely remarked that the name that belongs to them is wanted by its owners, and that it does not suit the hydrogen salts to which Gerhardt wanted to transfer it.

Mr. Foster goes into an elaborate exposition of what he conceives to be the original meaning of the word acid, and speaks of that "original meaning" as "anything but particularly clear." He might safely have called it "particularly cloudy."

Every chemist knows that the great Berzelius epitomised the prevailing definition by saying that an acid is an electro-negative oxide, and a base is an electro-positive oxide. No definition is complete and perfect; but this definition is certainly clear, and it does point to differences of properties among chemical compounds which are the most characteristic and important known to us. I cannot see any chance whatever of the words acid and base being given up; for they describe conveniently the chief differences of properties by which we classify compounds chemically. Mr. Foster's remark, that "the strictly scientific significance of the word acid has passed away," and that the word indicates "a distinction to which we now know that no real difference corresponds," must be taken as referring to Gerhardt's misuse of the word acid, as describing salts with basic hydrogen. He might have gone a step further in condemnation of that misuse of the word, and have shown that the word acid never has had any scientific significance as applied to hydrogen salts.

Mr. Foster quotes from my note (but apparently misunderstands) the statement, "In fact, he (Gerhardt) systematically applied the term acid to hydrogen salts, giving the name anhydride to acids, and leaving bases, however anhydrous they might be, entirely unprovided with a corresponding name." If bodies such as HNO_3, H_2SO_4, H_3PO_4 were considered to be entitled to the name "acid," then for precisely similar reasons, bodies such as KOH, $Ba(OH)_2$ would be entitled to the name "base;" and if the bodies N_2O_5, SO_3, P_2O_5, &c. formed by dehydrating these so-called acids are called "anhydrides,' then some corresponding and distinctive name should be given to the bodies K_2O, BaO, &c., formed by dehydrating the so-called bases. The absence of any such term is a deficiency sufficiently grave to make one pause in adopting the term anhydride in systematic language, until the idea which it represents is duly applied to the other great class of chemical compounds; but I cannot, with Mr. Foster, call it a "limitation;" and as I have not said that Gerhardt imposed any "limitation" in the matter, I may fairly be excused from accepting Mr. Foster's challenge to show where Gerhardt imposed it. If Mr. Foster were to deny my statement that the anhydrous bases are unprovided by Gerhardt with a name corresponding to that of anhydride for the acids, I might probably beg the favour of his quoting chapter and verse in support of his denial. But as matters now stand, the two great classes of chemical compounds are called acids (such as CO_2, SO_3, SiO_2, &c.) and bases (such as K_2O, CaO, Fe_2O_3, &c.), Whoever wants to take their names from them for the use of their hydrates must at least give them new names which will do as well. And he will certainly not be permitted to take the names from the two classes of bodies, and put them off with one name between them. Gerhardt seems to have thought that he would be permitted to do so, but the single substitute (anhydride) which he offered is admitted to be not only insufficient but absolutely unacceptable.

Perhaps the most important advantage which chemists have gained by representing all substances of known composition by typical formulæ, has been the increased clearness with which they have been able to compare the properties of bodies with one another, without the mind being encumbered by conventional differences of form. Even elements are now for the most part represented by formulæ analogous to those used in representing compounds; free hydrogen being HH like HCl, free oxygen being OO like CaO, free phosphorus being P_3P like H_3N, &c. The one great difference which stands forth above all other chemical differences, is that which is described in various terms, all more or less similar in import to acid or acid-like and basic or base-like. We have long since admitted that this fundamental difference is a difference in the degree in which various substances exert analogous effects, a weak acid acting like a base under the influence of a very strong acid, and a weak base acting like an acid to a very strong base. Among simple and well-known compounds this difference is most markedly represented by oxides such as SO_3, P_2O_5, SO_2, CO_2, CaO, K_2O, PbO, Bi_2O_3, &c.; and every chemist knows that compounds of the former class are electro-negative to those of the latter class, electro-negative oxides being called acids, and electro-positive oxides being called bases. It is admitted that hydrogen salts must be represented and named like other salts; hydric nitrate, or hydric phosphate, like potassic nitrate or potassic phosphate, and potassic hydrate or calcic hydrate like potassic nitrate or calcic nitrate; and Gerhardt's attempt to apply to bodies of the first class the name acid is, in the words of Mr. Foster "incorrect if it implies any peculiarity of constitution [different from other salts], and superfluous if it does not." Mr. Foster might, however, as above remarked, have added that Gerhardt's definition of the word acid is simply in itself devoid of meaning. He quotes it thus:—Acids are "salts whose *base* [the italics are mine] is wholly composed of hydrogen." A person ignorant of the meaning of the words acid and base could surely not ascertain from his inner consciousness which is the acid and which the basic constituent in any of the following compounds:—KOH, HNO_3, BaO_2H_2, SO_4H_2; and Gerhardt's pretended definition would afford him no aid in ascertaining which of these compounds are to be called acids, which bases. One is almost tempted to suspect Mr. Foster of bitter irony when he calls this definition "strictly scientific and logical." Although different in form, it is not one bit more reasonable than the Munchausen (or Irish?) feat of ascending to the moon by the aid of a mile-long chain, the traveller first fastening his chain by one end at a point one mile up, then climbing up by the chain to that point, and so on. But I am sorry to say that Gerhardt's disciple is even in a worse plight than the aëronaut, he is so unfortunately circumstanced that even if his chain were fastened one mile up, he could not climb up it. For if, as a preliminary to the understanding of Gerhardt's dictum, we are told how to find out which is the acid and which the basic constituent of a given compound, we find that this preliminary information is inconsistent with Gerhardt's dictum, and prevents our making any use of it. By the aid of a battery anybody could find out which are electro-negative, which the electro-positive oxides derivable from the above compounds; but Gerhardt would then reject the result as inapplicable to his purpose.

It has always seemed to me that the most plausible objection to the use of the terms acid and base in the sense of electro-negative oxide and electro-positive oxide was the fact that some acids, such as SO_3, P_2O_5, SiO_2, &c., may be put in contact with bases such as BaO, K_2O, &c., without manifesting any strong tendency to combine with them; and observations of this kind led some chemists to say that, in their chemical properties, these so-called acids do not behave like acids, and that it is therefore reasonable to deprive them of the name acid. Now the fact is that these acids always do combine with bases when brought in contact with them in the fluid state, and they combine with more force than that with which their hydrates react on basic hydrates. It is well known that when two saline molecules such as SO_4H_2 and BaO_2H_2 react on one another with liberation of water and formation of a salt, the force of combination, as measured by the heat evolved, is less than that which the acid and base exert in direct combination; for the process of double decomposition separates the water from SO_3 and from BaO, and in doing so absorbs just as much heat as was evolved when water combined with SO_3 and BaO; so that the force with which the two hydrates react on one another is by so much less than that with which SO_3 combines with BaO.

Mr. Foster expresses an objection to applying the term "combination" to the reaction of such bodies as anhydrous acetic acid $(C_2H_3O)_2O$ on water, because by a process of double decomposition the two molecules, acid and water, give rise to the formation of two new molecules; but if his objection is admitted to have weight, it applies equally to the reaction of free chlorine on free hydrogen, where two molecules of the elements form two molecules of the compound by a process of double decomposition. If such reactions as that of chlorine on hydrogen, and of anhydrous acetic acid on water, are not combinations, the word might perhaps be retained for such reactions as the combination of carbonic oxide and chlorine; or SO_3 and water, where two molecules unite to form one; but if Mr. Foster seriously proposes such a restriction of the word, it will be time enough to consider it. The present usage is to describe as combinations those reactions in which the resulting molecules are less various than the original molecules, as in the cases of—

$$O_2 + (H_2)_2 = (H_2O)_2 ; \; Cl_2 + K_2 = (ClK)_2 ;$$
$$N_2O_5 + H_2O = (NO_3H)_2 ; \; (C_2H_3O)_2O + H_2O = (C_2H_4O_2)_2, \text{ \&c.}$$

and, in like manner, to describe as decompositions those reactions in which the products are more various than the materials, as—

$$SO_4H_2 = SO_3 + H_2O ; \; Pb(NO_3)_2 = PbO + O + N_2O_4 ;$$
$$(C_2H_3KO_2)_2 = C_3H_6O + CO_3K_2 ; \; (HgO)_2 = 2Hg + O_2,$$
$$\left[\begin{matrix}C_2H_5\\H\end{matrix}O\right]_2 + SO_4H_2 = \left[\begin{matrix}C_2H_5\\C_2H_5\end{matrix}O\right] + H_2O + SO_4H_2.$$

Many of these processes are known to consist of a series of double decompositions, and the fact is often mentioned in alluding to them; but it does not seem likely that we should abandon the use of the terms combination and decomposition.

Mr. Foster has discussed in his paper what he calls the original use of the words acid and base, which is sufficiently characterised by his own words, "anything but particularly clear." He has also discussed Gerhardt's misuse of the word acid. His conclusion that the word had better be given up, would be quite worthy of serious consideration if the words were only used in those improper senses. But the words acid and base really mean something not only true, but of fundamental importance, which we are constantly obliged to consider and speak of in chemistry; and I am quite sure that it would be utterly beyond my power to take from them their established meaning, even if I wished to do so. There is at present a considerable amount of inconsistency in the prevailing use of these, as of most other scientific terms; and Mr. Foster's interesting paper affords further arguments than those which I had given in favour of abandoning as speedily as practicable the misuse of the terms which has crept into partial use through popular disregard of water in hydric sulphate, and which Gerhardt unsuccessfully endeavoured to incorporate with scientific language.

I have not discussed the proposal to call both acids and bases oxides, because it has not as yet received sufficient development to enable me to form any opinion upon it beyond the obvious objections which present themselves at first sight to so grave a change. Thus, MnO, Mn_2O_3, MnO_2, MnO_3, Mn_2O_7 are at present conveniently distinguished by names, calling the last two acids, and the first two oxides; and so also CO and CO_2 are very conveniently distinguished by the words oxide and acid. Another circumstance which would alone have been sufficient to prevent my offering any opinion on this proposal is the fact above explained, that it is founded on Mr. Foster's opinion that the word acid is not clear, and is unworthy of being retained.—*Philosophical Magazine for June*, 1865.

University College, London, May 16, 1865.

TECHNICAL CHEMISTRY.

On the Electro-Chemical Preparation of Metalloids.[*]

PURPOSING to speak only of unpublished methods, we need not now speak of ozone. Several distinguished chemists are actually endeavouring to find some relation between the state of the atmosphere and the quantity of ozone present in it. We have never been able to admit the presence of free ozone in the air. How should oxygen, which, when electrified, attacks the metals, and all matters in the least oxidisable, respect nitrogen, water vapour, organic substances—in a word, all that the air contains? This question will not, however, be definitively settled until a sufficiently certain and special reagent for ozone be found.

Electro-chemistry is now a complete science; for all simple bodies, and for the greater number of their principal compounds, it gives a mode of preparation which, under most circumstances, is even preferable to that offered by pure chemistry. We will first pass in review the metalloids whose preparation by this means is most worthy of interest.

Nitrogen must thus be isolated in a pure state—it

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[*] *Cosmos*, 2nd series, 1, 595.

must, in fact, be extracted from ammonia or nitric acid; now in either case it undergoes a secondary action, resulting from the decomposition of water.

Chlorine, bromine, and iodine are easily obtained by following the same method.

The process consists in decomposing in a U-shaped tube the hydrogenated combination of the metalloids, using graphite conductors as the electrodes; the orifices of the tube communicate with washing flasks, and hence the purified gases pass into the receivers. By operating on hydrochloric acid, chlorine is disengaged from the positive pole in a state of absolute purity; it is the same when acting on a fused alkaline earthy chloride.

Bromine is a liquid which is a bad conductor of electricity; its electro-chemical treatment requires, then, that it should be maintained in solution in water; if not, it becomes necessary to use a great number of voltaic couples. As for iodine, we know how easily iodised compounds decompose under the influence of the weakest electric current; however, to collect the iodine at the positive pole, it must be dissolved as it decomposes, for its crystals, fixed on the electrode, will oppose the passage of the current. If electricity has hitherto remained powerless to isolate fluorine, it is because physicists and chemists have been unable to find the relation existing between the constitution of fluorides and the electric force to be put in play. If chemical affinity is conquered by electricity, in the generality of compound bodies, no exception can exist. Only we must know how to apply this antagonistic force of affinity, and especially to oppose secondary reactions; it is effects of this kind which have prevented M. Becquerel's collecting fluorine. The isolation of this metalloid is considered almost impossible, because of its affinity for hydrogen and chlorine; M. Becquerel has, however, succeeded in separating it from one of its metallic combinations in the following manner:—He placed on a receiver a small platinum spiral, terminating in a point, and on which were deposited fragments of fluoride of calcium; the two ends communicated with two platinum wires, larger in diameter than that of the spiral, passing through two openings made in the sides of a receiver; these wires were connected with a Wollaston's pile composed of twelve elements (this kind of pile gives, as is well known, a current very powerful in intensity and in quantity). The receiver being placed on the plate of the air-pump, and the air dried, a vacuum was formed; then the electricity was called into action. The incandescence of the spiral was very vivid for several seconds; the current was interrupted, and the air allowed to enter, when the fluoride of calcium was found partly decomposed; it reddened turmeric paper, and the surface of the platinum was found covered with a greyish pellicle, seeming to indicate the action of fluorine. From this experiment it would appear possible to isolate fluorine. Induction currents might perhaps be employed with success, for it seems necessary for the decomposition of any kind of fluoride, to develope electricity more especially of tension than of quantity.

The electro-chemical separation of sulphur is certainly not of importance for industrial chemists, but it is for those studying the different physical states which may be assumed by this body in its combinations; from this point of view the following experiment is very interesting:—

Into a glass vessel pour a solution of sulphate of copper, into another an alcoholic solution of sulpho-carbonate of potash; then establish a communication between the two liquids—on the one hand, by means of a bent glass tube filled with clay, moistened with a solution of nitrate of potash; and on the other with a metallic arch of copper and lead, the copper being plunged into the sulphate of copper, and the lead into the sulpho-carbonate. The current thus engendered is sufficiently energetic to decompose the sulphate of copper; secondary reactions, which it would be useless to analyse, are produced, and the sulphur of the sulpho-carbonate of potash, partly isolated, is deposited in the form of octahedra, with rhomboidal bases on the lead plate. By making electricity act on hydrosulphuric acid, M. Berthelot found that sulphur deposited at the positive pole did not assume this form. Electricity may then be employed, provided it is properly applied, in studying the molecular constitution of polymorphous bodies, in their various combinations. Only it is necessary that the intensity of the electric force should be in proportion to the affinity causing the combination.

It is difficult to obtain tellurium in a compact mass by the electro-chemical method; Ritter could only extract it from a saline solution in a pulverulent state.

Arsenic is of all metalloids most easily isolated by electricity, for it is almost as good a conductor as a metal. By means of an apparatus (known as *simple* in electro-chemistry), all the metalloid they contain may very rapidly be extracted from arseniferous substances. Place a solution of arsenical matter in a platinum vessel, plunge a zinc wire into the liquid, and the arsenic will appear on the platinum; by prolonging the action the whole of the arsenic is extracted from its compound. This method may be varied in different ways, and renders valuable service in medico-legal researches; it is much superior in sensibility to the process actually in use.

Boron has not yet been obtained on the electrode; however, it has been electro-chemically isolated by Davy. "When boracic acid," he says, "is exposed between two surfaces of platinum, receiving, at the same time, all the action of five hundred pairs, an olive brown matter is formed on the negative surface, gradually increasing in thickness, and finally becoming black. Insoluble in water, but soluble, with effervescence, in nitric acid. Heated to redness on platinum, it burns slowly, producing a white vapour, which reddens litmus paper."

The isolated body is therefore boron, which oxidises immediately, and the electric action should cease as soon as the platinum is covered, this metalloid being an extremely bad conductor.

Silicium is, with respect to conductibility, analogous to boron. Davy was unable to isolate it, even by a pile formed of a very large number of elements. M. Becquerel has obtained crystals of silicium by combining physical and chemical forces—he took two tubes of three to four millimetres in diameter and one decimetre long; one end of each tube was filled with clay moistened with salt water. By this end the tubes were plunged into a vessel also containing salt water; into one was poured a saturated solution of gelatinous silica, in hydrochloric acid, and in the other a saturated solution of chloride of sodium; a zinc wire was plunged into the latter, and a platinum wire into the former communication being established between these two wires, an electric current was produced, the hydrochloric acid decomposed, and the nascent hydrogen reduced the silica; crystals of silicium appeared on the platinum, and remained so long as the current passed; they redissolved when it was interrupted.

To preserve them they must be rapidly removed, washed, and then dried in a vacuum, and kept in a tube with potassium.

DUBLIN INTERNATIONAL EXHIBITION.

By CHAS. R. C. TICHBORNE, *F.C.S., F.R.G.S.I., &c.*

(Continued from vol. xi., page 295.)

PLATINUM *v.* GLASS.

SINCE our report upon the case shown by Messrs. Johnson and Matthey, we have received a letter from that firm in which they repudiate the idea that the manufacturers are returning back to the glass. We are very glad to learn this, as no doubt can be entertained of the superiority of the metal in many respects. The writer is also in a degree pleased that he has been the means of bringing forward a contradiction to statements and impressions which had certainly taken hold of the chemical public.

The author is not a manufacturer of sulphuric acid himself, and therefore can only judge of the facts that come within his observation. We have the following passages occurring in the most important chemical report ever published, the said report being written upon the largest exhibition ever held in Europe:—"Nevertheless the platinum alembics have disappeared from many of the British sulphuric acid works, and the manufacturers are returning to the old method of evaporating in glass." Again, "In Lancashire the use of platinum retorts has been entirely abandoned." These facts in connexion with a visit made by the author to one of the largest manufacturers in the kingdom (not in Lancashire), who had also given them up, were quite sufficient to justify his remarks. Against them we have a case where a manufacturer has returned a second time to the platinum. There can be no doubt that where the advantages and disadvantages are anything like equally balanced, fashion creeps in even in hard matter-of-fact practical processes, and this may account why, in Messrs. Johnson and Matthey's opinion, a retrograde movement has taken place to a certain extent; and we are inclined to think with them that it is a retrogade movement. Of so much importance does the author consider the subject (for sulphuric acid may be viewed as the progenitor of chemical products), that, having received Messrs. Johnson and Matthey's permission, a few extracts from their note are given:—

"We would, however, ask you to modify your views as regards the platinum system for concentrating sulphuric acid, assuring you that the statements made are essentially contrary to fact. We have never for forty years past been so much engaged in the manufacturing of platinum boilers as we have been lately. This is practically the strongest evidence of the advantage of the platinum over the glass system. . . At the present moment we can instance a manufacturer who originally worked with platinum, and was induced to give it up in favour of glass, and after incurring the expense of the sacrifice of the platinum plant, and that of setting up the numerous furnaces required for glass working, has lately taken down the whole of the latter, and is again using the platinum, assuring us that the saving in fuel alone very greatly exceeds the interest, &c., of the platinum plant. . . We can go further than this, and state upon well-proved statistics that the saving in fuel and working expenses and space, will in five years pay in full for the cost of platinum vessels; after which time not only is there the extreme profit over the glass system, but an intrinsic value in the plant. Also there is the advantage of great rapidity and certainty in working, and above all, of absolute safety to the workman employed. . . It may interest you to know that a committee of the directors of some of the Continental manufactories lately visited England for the express purpose of reporting upon the two systems, and after a thorough investigation, although they came with a strong prejudice in favour of glass, they have unanimously reported in favour of platinum system. . . We should be sorry for an erroneous opinion to be promulgated on this subject, although this may be considered rather an interested statement on our part.—We are, dear Sir, yours very faithfully, JOHNSON, MATTHEY, AND CO.—C. Tichborne, Esq., Dublin."

Scientific Instruments (*Continued*).—The following firms show fine specimens of scientific instruments, but principally cameras, microscopes, surveyors' instruments, and barometers:—Mr. S. Yeates, Dublin; J. H. Dallmeyer, London; Crouch, Bros., of London, who also show some very fine microscopic photographs of a considerable size. More is frequently to be gained from the study of these photographs than by ocular examination of the object when in the microscope. H. Webb, of Birmingham, shows what appears to be a very fine collection of microscopic objects, as far as an opinion can be given without an examination under the instrument. Field and Sons, Birmingham, exhibit their wonderfully cheap microscopes.

John Young, of Dalkeith, shows moulded carbon for electric batteries. This gentleman first undertook the task of making a series of experiments in connection with the above subject at the request of several gentlemen interested in the progress of electrical science. The carbonaceous material (coal, &c.) is ground to a very fine powder, moistened, and moulded into the form wished, in a similar manner to the making of bricks. The forms so moulded are then slowly dried, and, when dry, packed into iron moulds, and subjected to a bright heat in a close oven. The effect of the heat is to drive off the whole of the bituminous matter, leaving a dense and compact coke in the moulds. The pieces are then boiled in pitch, and again charred along with a charge of coal in a gas retort. This is repeated several times, until the required density is attained. They are then ground into the proper shape, and smoothed on the surfaces. They are then kept for twelve hours in a gas retort, along with coal, the latter being used to produce carbonaceous vapour, which saturates and closes the pores in the coke. When the process is properly conducted, the carbons are taken out, possessing a close metallic steel-grey surface. They are much more porous than retort carbon, by which they acquire high electro negative qualities.

We must not forget to notice the patent flexible diaphragms for covering the surface of liquids which would be affected by the atmospheric oxygen. This patent includes vessels wholly lined with sheet india-rubber, or having a diaphragm which floats loosely upon the surface of the liquid. The liquid is hermetically sealed to the extent of the non-porosity of india-rubber, but we believe that this substance is still capable of allowing the diffusion of gases to a limited degree.

The following few articles that we are about to notice cannot be classed as scientific instruments, but still possess such interest in a technical point of view that the present article would hardly be complete without touching upon them. One of them is Messrs. Morton's patent refrigerator. This arrangement may be viewed as a worm, except that the wort or liquids to be cooled are made to traverse the exterior of the metallic tubes, in which is circulating the cooling medium. This apparatus consists of a series of flattened tubes made of strong copper (tinned), and connected at the ends alternately by the caps, so as to admit of a continuous flow of cold water inside the tubes. The whole is fixed to a copper case, and secured in a strong wood frame. The worts are admitted at the other end, and flow in an opposite direction to the water alternately under and over the tubes, this motion being produced by the longitudinal ribs on the top and the corrugated bottom. The absolute necessity for the rapid cooling of worts, says the circular, is now fully recognised by all brewers who have made the chemical laws which govern vinous fermentation their study.

The applications of graphite—or black lead, as it is sometimes called—have become more numerous of late; thus it is extensively used for electric purposes, the glazing of gunpowder and shot, black lead pencils, and last, but not least, the making of plumbago crucibles.

The Patent Plumbago Crucible Company exhibit specimens of their crucibles, so well known to metallurgists. Mr. Brodie's well-known and beautiful process of disintegrating graphite has enabled the most inferior qualities of that mineral to be made available. The Plumbago Crucible Company, however, purify their graphite by passing chlorine through it when heated to redness, or in some cases simply by separating the iron, which is the great impurity, by magnets. The graphite so prepared answers their purpose as well as Mr. Brodie's, and is less expensive.

It is stated that a large deposit of graphite has recently been discovered by an enterprising Frenchman, M. Alibert, in the Batougal Mountains of South Siberia. It may be mentioned that the higher class graphite in this deposit is accompanied by an inferior variety which, as it appears from experiments made by Mr. Valentine, can be easily purified. The Siberian plumbago is not much used at present by the Plumbago Crucible Company, as it contains top much iron, and although this could be entirely removed by the company's patent process, it is found cheaper to work with Ceylon plumbago, which contains but little iron. The graphite used by them contains 98 per cent. of pure carbon. The company exhibit Ceylon, Siberian, and other graphites in their case.

To show the importance of this branch of manufacture the following facts may be cited:—The consumption of Ceylon graphite at the Battersea Works has had an extraordinary effect upon the price of the article. When the company commenced business it cost about 10*l.* per ton, but now it cannot be bought at double that price. In Ceylon applications to dig graphite are daily on the increase, notwithstanding the rate of 14s. per ton which has to be paid as royalty at the Colombo Cutcherry. The following figures, giving the amount of revenue collected at Colombo and Galle, on account of royalty, in 1862 and 1863, clearly show the extraordinary increase in demand for Ceylon graphite:—

	Increase in 1863 from 1862.
Western Province . . .	800*l.*
Southern Province . . .	170*l.*

The total quantity of graphite exported from Ceylon in 1862 was 40,195 cwt., of which no less than 34,730 cwt. was shipped to Great Britain. The Patent Plumbago Company are the principal consumers of the latter. M. Dierick writes* the following of these crucibles:—"Each crucible runs from forty to sixty pourings, and can with safety be dipped in cold water when at a red heat, and used again immediately as if it had not undergone any change of temperature; the metal is also fused much more rapidly, saving time, fuel, labour, and waste. The saving of metal is also very great, as to each worn crucible there adheres a certain amount of metal; the commoner the crucible, the greater the absorption and adhesion."

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* M. Dierick, Master of the French Mint.

PROCEEDINGS OF SOCIETIES.

ON THE PRESENT STATE OF THE CHEMISTRY OF GAS LIGHTING.

By HENRY LETHEBY, *Esq., M.B., &c.*

Delivered at Birmingham, before the Society of Gas Engineers.

GENTLEMEN,—I propose that we should continue to-night our inquiries into the chemistry of gas lighting—that, in fact, we should extend our investigation into the subject which was commenced at the meetings of this Association last year at Manchester, when, as some of you will remember, I directed your attention to the chemical principles involved in the manufacture and purification of coal gas. On the present occasion we will examine the leading physical, chemical, and photometrical properties of the most important constituents of coal gas.

Briefly to recapitulate the subjects of the last lecture, I may remind you that we inquired, in the first place, into the composition and probable origin of the material out of which gas is produced—coal; that we then examined the leading constituents of the several varieties of coal which are best suited for the manufacture of gas, especially directing attention to the form in which the most objectionable impurity (sulphur) of coal existed. We also considered the phenomena of carbonisation or distillation of coal, and saw how much it was influenced by temperature, and how, under the influence of heat, the elements moved from their old states of combination into new.

We then discussed the composition of raw gas as it leaves the retort, and I pointed out to you that it consists of the constituents marked in the following table:—

Constituents of Raw Gas.

Tar matter.
Aqueous vapour.
Carbonic acid.
Ammonia.
Cyanogen.
Sulpho-cyanogen.
Sulphuretted hydrogen.
Bisulphide of carbon.
Sulpho-hydrocarbons.
Nitrogen.
Oxygen.

Hydrogen.
Light carburetted hydrogen.
Carbonic oxide.
Condensable hydrocarbons.

Now the whole of these constituents above the line may be regarded as impurities, and I pointed out to you that the taking of these impurities out of coal gas, in order to effect the perfect removal of them, involved a proper order, as it were, of purification—that, in the first place, both science and practice pointed to the fact that the condensation or cooling of the gas should not be too sudden; that the longer the gas was kept in contact with tar and ammoniacal liquor before it went to the condensers the better. It had been seen in numerous instances that a long hydraulic main, extending a considerable distance from the retorts, always effected the condensation of naphthaline as well as objectionable sulphur compounds; and I further pointed to the fact that when the gas had traversed the condensers it was never fairly purified if it left them at a higher temperature than 60° Fahr. The aim, in fact, should be slow but complete condensation by gradual cooling, for if the temperature of the gas exceeded 60° the ammoniacal liquor was never of its full strength, and much sulphur, ammonia, carbonic acid, and aqueous vapour passed on to the purifiers, where such impurities were seriously in the way.

The next question is how to remove from the gas the sulphuretted hydrogen, the ammonia, and the other impurities which still remain in it. In continuation of the system already adverted to, it is well to submit the gas to the action of a copious stream of ammoniacal liquor after it leaves the purifiers. As far back as the year 1846, Mr. Lowe directed attention to this, and he patented a process for effecting it. Very recently Mr. Hawksley has, from independent observations, and from a chemical consideration of the subject, recommended a like process.* He advises that the gas should be drenched with ammoniacal liquor to the extent of a sixteenth of the volume of the gas. The effect of this is to strengthen the liquor and to remove from the gas ammonia, sulphuretted hydrogen, carbonic acid, and the objectionable compounds of sulphur with carbon, and the hydrocarbons. In practice it is found that the gas thus treated never contains more than twelve grains of sulphur in any form in 100 cubic feet—the average being about nine and a-half grains; and, to use the words of your president, "it thus appears that all considerable gas companies may, by a very simple, and in other respects very useful process, remove a large proportion of the objectionable sulphur compounds which usually continue to exist in coal gas after it has been passed through lime or other metallic oxide."

The residual impurities—namely, the ammonia, sulphuretted hydrogen, and carbonic acid are next to be removed in proper order. Washing the gas with water, or with weak ammoniacal liquor, and finally with water, will at once abstract a considerable amount of all these impurities; and although there is a prejudice with some engineers that this kind of purification is objectionable on account of its lowering the illuminating power of gas, yet, as we shall see hereafter, the prejudice is not founded on fact—excepting that the process undoubtedly removes such compounds as tar and naphthaline, which, though of high illuminating power, are nevertheless better out of the gas than in it, seeing how much mischief they do by subsequent deposition in the mains and service pipes. You will have an opportunity of seeing at the Saltley station of the Birmingham and Staffordshire Gas Company, in this town, the good effect of thoroughly washing the gas with water or weak ammoniacal liquor before it passes to the purifiers. Mr. Young, the experienced engineer of the Company, has for some time past adopted this practice. The gas, on leaving the condensers, traverses successively three washers, or as they may be more properly called, douche scrubbers; each of them is 25 feet high, 8 feet long, and 4 feet wide; and the liquor or water is delivered into them at the rate of 1815 gallons an hour, the gas passing at the rate of about 66,000 cubic feet an hour. The water or liquor flows through a pipe or jet with a very small orifice, and dashing upon a disc immediately below it, is splashed out into a fine shower which meets the ascending gas. The rate of flow, therefore is about 27½ gallons for every 1000 cubic feet of gas. In this manner the gas is thoroughly cleansed before it goes to the purifiers, and the contrivance is such that no pressure is put upon the gas, for it passes through the washers without friction. The quantity of ammoniacal liquor which is thus obtained amounts to 44 gallons per ton of Stavrley coal, the strength of the liquor being 4 of Twaddle, or about 8 ounces of sulphuric acid. Before this process was adopted, the quantity of liquor of the same strength was only 25 gallons per ton; and the profit arising from the sale of the liquor is more than 2000*l*. per annum in excess of the former returns. I find from an examination of the gas, that its illuminating power is from 15 to 16 sperm candles of standard quality, and that there is no loss of power by deposition in the mains—the gas, indeed is absolutely free from ammonia, naphthaline, and carbonic acid, and the amount of sulphur in any form does not exceed 16 grains per 100 cubic feet. When the gas has been thus washed, it contains but little ammonia, so that a tray of acid sawdust in the purifier remains for months without being saturated. After this complete removal of ammonia, the gas should be submitted to the action of wet lime, or, failing this, on sanitary grounds, to oxide of iron; and lastly to a few trays of dry lime to remove carbonic acid, which, as I shall show you directly, is a very objectionable constituent of gas, on account of its lowering the illuminating power.

The order, then, of purification is:—1st, slow but complete cooling; 2nd, washing with ammoniacal liquor; 3rd, the removal of ammonia by water or acid; 4th, the abstraction of sulphuretted hydrogen by lime or oxide of iron; and 5th, carbonic acid. I have been particular in recapitulating all this because of its great importance in the manufacture of good gas.

We will now pass on to the proper subject of the lecture—namely, the examination of the chief constituents of purified coal gas. These may be classed under three heads:—

1. The combustible non-illuminating constituents.
2. The illuminating hydrocarbons.
3. The impurities.

1. *The Combustible Non-Illuminating Constituents of Coal Gas.*

These form a very large proportion of its bulk—as from 30 to nearly 60 per cent. They are hydrogen and carbonic oxide; and their sole function seems to be the purveying or carrying the illuminating hydrocarbons.

(a) HYDROGEN (H) exists in coal gas to the extent of from 12 to nearly 50 per cent. It is in greatest abundance in poor gas of low illuminating power, and it no doubt comes in great part from the decomposition of the richer hydrocarbons by the high temperature of the retorts. It is also produced by the moisture of the coal giving up its oxygen to the red-hot carbon, and setting free its hydrogen. The gas is singularly inert—it has no colour, no taste, no odour, and no action on the human body. It is the lightest body known, its specific gravity being 0·0692, atmospheric air being 1; and 100 cubic inches of it weigh only 2·15 grains, the same quantity of air weighing 31 grains. It burns without any light; and, as you perceive when I hold a cold glass over the flame, the product of its combustion is water. One cubic foot of hydrogen requires half a cubic foot of oxygen, or 2½ cubic feet of atmospheric air, for combustion. The temperature of the flame is very high—about 5898° Fahr., and a cubic foot of the gas, in burning, will raise 5220 ounces of water, or 16,250 cubic feet of air, 1° Fahr. Lastly, it is but slightly absorbed by water—100 volumes of water taking up about 1·93 of hydrogen gas; and it is not condensable by cold or pressure.

(b) CARBONIC OXIDE (CO) is a compound of one proportion of carbon and one of oxygen. By weight, therefore, it consists of 6 parts of carbon and 8 of oxygen; and by volume, of half a volume of carbon vapour and half a volume of oxygen, united without any condensation. It is not a large constituent of coal gas, the proportions ranging from about 5 to 16 per cent.; but it forms a considerable part—about 34 per cent.—of the gas made by the decomposition of steam by red-hot carbon. This, indeed, is the chief source of it in common coal gas. Like hydrogen, it is colourless and odourless; but, unlike it, it is a deadly poison. I have ascertained that 2 per cent. of it in air will kill birds almost instantly; and, according to Leblanc and Dumas, an atmosphere containing one per cent. of it will kill a small dog in a minute and a-half. It is a little lighter than atmospheric air, in the proportion of 0·967 to 1; and 100 cubic inches of it weigh nearly 30 grains. It burns with a pale bluish and somewhat opaque flame; and, as you here see, it forms nothing but carbonic acid. The flame cannot be got from the small jet over the governor. I am obliged to burn the gas from a very large jet over the pneumatic trough, and therefore I am not able to show you the size of its flame in comparison with coal gas. In the act of burning, 1 cubic foot of carbonic oxide consumes half a cubic foot of oxygen, or 2½ cubic feet of

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* *Journal of Gas Lighting*, vol. xiii., p. 542.

air; and the heat of the flame is very nearly as great as that of hydrogen, it being 5508° Fahr. A cubic foot of it will raise the temperature of 5400 ounces of water, or 16,500 cubic feet of air, 1° Fahr. It is but slightly absorbed by water—100 volumes absorbing 2·43 volumes—but it is very freely absorbed by a strong solution of sub-chloride of copper; and this is the agent used for its detection in coal gas.

2. *The Illuminating Constituents (Hydrocarbons) of Coal Gas.*

These are all compounds of carbon and hydrogen; hence their name, hydrocarbons. And as, in the same volume of the gas, there are very different proportions of carbon, the illuminating power of these several constituents varies considerably. In all cases the light which they evolve in the act of burning is due to their decomposition by the heat of the flame, and to the suspension of the liberated carbon for a definite time in an ignited state.

The following are the principal members of this group, beginning with the least illuminating:—

Marsh Gas, C_2H_4; Olefiant Gas, or Ethylene, C_4H_4; Propylene, C_6H_6; Butylene, C_8H_8; Acetylene, C_4H_2; Benzol, $C_{12}H_6$; Naphthaline, $C_{20}H_8$, and perhaps some others.

(a) **Marsh Gas** is also called Pit Gas, Fire-damp, Light Carburetted Hydrogen, and Hydride of Methyl (C_2H_4). A volume of the gas contains half a volume of carbon vapour, and two volumes of hydrogen. It is a large constituent of the gas evolved from sewage, and the mud of a stagnant pool. It also forms from 79 to 91 per cent. of the fire-damp of coal mines, and it constitutes from 30 to 60 per cent. of coal gas. It is colourless, odourless, tasteless, and without action on the animal body, for miners breathe it with impunity. It is a little more than half the weight of atmospheric air—its specific gravity being 0·5531; and, therefore, 100 cubic inches of the gas weigh 17·15 grains. It burns, as you perceive, with a pale yellow flame, which is bluish for a considerable distance up, the height of the jet being somewhat less than that of coal gas; and so also is its illuminating power. A cubic foot of gas consumes 2 cubic feet of oxygen, or 10 cubic feet of air; and the products of the combustion are a cubic foot of carbonic acid, and aqueous vapour. The heat of the flame is about 5890° Fahr., and a cubic foot will raise 16,920 ounces of water, or 52,000 cubic feet of air, 1° Fahr. The gas is but slightly absorbed by water—100 volumes taking up 3·91 of the gas. It is not absorbed by chlorine, except after some time, and in the light; nor by bromine or fuming sulphuric acid; and it is not easily decomposed by heat; nor is it condensed by cold. There is no immediate test for the gas.

Besides marsh gas, there are probably other members of the series present in coal gas, as Ethyl-hydride (C_4H_6), Propyl-hydride (C_6H_8), Butyl-hydride (C_8H_{10}), and Amyl-hydride ($C_{10}H_{12}$), all of which are found in the petroleums of commerce.

(b) **Olefiant Gas, Ethylene, or Elayl** (C_4H_4), is a gas which contains twice as much carbon in a given volume as the last—a volume of it contains its own bulk of carbon vapour and two volumes of hydrogen. It exists in fire-damp to the extent of from 2 to 16 per cent., and in coal gas too from 8 to 27 per cent., cannel gas containing it in the largest proportion. It is colourless, and, when pure, is a little ethereal or sweetish in its odour, and it is anæsthetic or stupifying in its action on the body when it is inhaled. It is very nearly as heavy as atmospheric air—its gravity being 0·967; and, therefore, 100 cubic inches of it weigh nearly 30 grains. It burns with a long, bright yellow flame, the illuminating power of which is fully twice as great as the last. A cubic foot of the gas requires 3 cubic feet of oxygen, or 15 cubic feet of air for its combustion, and it produces 2 cubic feet of carbonic acid, and much aqueous vapour—evolving about one-third more heat than the last. When mixed with twice its volume of chlorine gas and fired, its hydrogen is consumed, and its carbon is deposited in the form of soot. It is also slowly absorbed by chlorine, in the dark as well as in the light, forming a heavy oily liquid of an ethereal odour, called Dutch liquid ($C_4H_4Cl_2$). In like manner it is absorbed by bromine, and by fuming sulphuric acid. The gas is slightly soluble in water, to the extent of about one-eighth of its volume, and it is freely soluble in alcohol, ether, volatile oil, and fixed oil. Turpentine, for example, will take up twice and a-half times its volume of the gas, and olive oil will absorb its own volume of it. It is easily decomposed by heat—a red heat converting it into carbon and marsh gas, together with a small quantity of tarry matter; and the gas is condensable by great cold and by pressure. The test for the gas is bromine or fuming sulphuric acid, which freely absorb it.

(c) **Propylene**, or, as it sometimes termed, Tritylene (C_6H_6), is a compound of carbon and hydrogen in the same percentage proportions by weight as the last; but a volume of it contains 1½ volume of carbon vapour and 3 volumes of hydrogen. Its proportion in coal gas has not been accurately determined. It is colourless, and has a stupifying action on the body. It is just half as heavy again as atmospheric air—its specific gravity being 1·455; and, therefore, 100 cubic inches of it weigh about 45 grains. It burns with a bright yellow and somewhat sooty flame, which is fully three times as long as the comparison jet of coal gas burning from the same sized orifice, and under the same pressure; and the light evolved from it is about three times as great as that from common coal gas. A cubic foot of it requires 4½ cubic feet of oxygen, or 22½ cubic feet of air, to burn it; and it produces 3 cubic feet of carbonic acid, and much aqueous vapour. The heat evolved by it is also very great. It is but slightly absorbed by water, but it is freely absorbed by chlorine, bromine, and iodine, forming compounds which correspond to Dutch liquid. It is also absorbed by fuming sulphuric acid, and even by strong oil of vitriol. The volatile and fixed oils dissolve it, and so also does a solution of proto-chloride of copper. As in the last case, it is readily decomposed by a red heat, forming marsh gas, and depositing carbon; and it is also condensed by cold and pressure.

(d) **Butylene, Tetrylene, Ditetryl**, or Oil Gas (C_8H_8), is a still further condensation of carbon and hydrogen in the same per-centage weights as in olefiant gas. A volume of butylene contains two volumes of carbon vapour and four of hydrogen. It is a large constituent of oil gas, and it exists in cannel gas to the extent of about from 3 to 4 per cent. Common gas contains it in very small proportions. The gas is colourless, and it has a peculiar odour. Its action on the body is not known, but no doubt it is anæsthetic, like the other hydrocarbons of this series. It is nearly twice as heavy as atmospheric air, its gravity being 1·935; and, therefore, 100 cubic inches weigh just 60 grains. It burns, as you perceive, with a long sooty flame, the jet being nearly four times as long as the comparison jet of coal gas; and the illuminating power of it is about four times as great as the jet of common gas. A cubic foot of the gas requires 6 cubic feet of oxygen, or 30 cubic feet of air, to burn it; and the products of its combustion are 4 cubic feet of carbonic acid and much aqueous vapour. Like the other hydrocarbons, it is but slightly soluble in water, but it is freely dissolved by alcohol and by the fixed and volatile oils; olive oil, for example, absorbs about six times its volume of the gas. It is also absorbed by chlorine and bromine, forming compounds analogous to Dutch liquid; and it is likewise freely absorbed by sulphuric acid, a volume of the acid taking up 100 volumes of the gas. If it is passed through a red-hot tube, it is decomposed and resolved into marsh gas, hydrogen, and carbon. It is also easily condensed by cold and pressure, forming a thin, transparent, and colourless oil, of which I show you a specimen. In the days of oil gas when the Compressed Gas Company was in existence, this ethereal oil was produced in rather large quantity; 1000 cubic feet of the gas submitted to a pressure of 30 atmospheres produced about a gallon of oil, composed almost entirely of butylene, with benzole and an oil of doubtful composition. It was from this mixture that Faraday obtained butylene.

(e) ACETYLENE, or Klumene (C_4H_2). A volume of this gas contains its own volume of carbon vapour and one volume of hydrogen. The gas exists in but very small proportions in coal gas; and it is remarkable as being a hydrocarbon which can be obtained by the direct union of carbon with hydrogen, by igniting carbon, by the aid of electricity, in an atmosphere of hydrogen. It can also be obtained by exposing a mixture of carbonic oxide and marsh gas to the action of a high temperature,—a circumstance which may hereafter be of practical utility in the manufacture of gas. It is likewise a product of the decomposition of hydrocarbons by heat. The gas is colourless, with a peculiar odour, and it is probably anæsthetic. It is a little lighter than air, the specific gravity of it being 0·898; 100 cubic inches therefore weigh just 28 grains. It burns with a brilliant light, as you here perceive, and with a sooty flame, considerably longer than the flame of coal gas; and when I mix it with a large volume of hydrogen gas, it still burns with a bright flame. A cubic foot of the gas requires 2½ feet of oxygen, or 12½ feet of air, to burn it; and it produces two volumes of carbonic acid, and aqueous vapour. The gas is freely absorbed by water to the extent of its own bulk, and it is again expelled unchanged when the water is boiled. It also combines, with great energy, with chlorine, bromine, and sulphuric acid. The best absorbent for it is a solution of ammonio-subchloride of copper. The solution is made by mixing a dilute solution of chloride of copper with an equal bulk of pure muriatic acid, and shaking the mixture in a bottle with copper filings, or boiling it with copper turnings until it is colourless. The solution is then put into a bottle or flask, with three tubes adapted to it: one for delivering the coal gas into the solution, a second for the exit of the gas, and the third for pouring in a strong solution of ammonia. When the gas has displaced all the air from the bottle, ammonia is poured into the solution until a deep blue liquid is obtained; and this, as you here see, absorbs the acetylene of the gas, and produces a chocolate or reddish brown precipitate of acetylide of copper ($C_4H_1Cu_2$), which is a compound in which two proportions of copper have replaced one of hydrogen. This acetylide of copper is to be collected on a filter, washed with water, and dried. If it is heated in a flask, as I am now doing, with dilute muriatic acid, it is decomposed, and the acetylene escapes with effervescence. You will notice, too, with what a bright yellow flame the gas burns.

(f) BENZOL, or, as it is sometimes termed, Benzine, Phene, or Bicarburetted Hydrogen ($C_{12}H_6$). One volume of this vapour contains three volumes of carbon vapour and three of hydrogen. It exists in coal gas in very variable proportions. At times it is but barely discoverable, and at other times it is present in large quantity. It is often present in London gas to a considerable extent, and I attribute it to the practice which is occasionally followed of pouring light naphtha into the mains for the purpose of removing naphthaline. I here show you a specimen of nitro-benzole obtained from only 15 cubic feet of gas. The vapour of benzole is colourless, and it has a peculiar odour, which is rather agreeable when the benzole is pure. It is powerfully anæsthetic, and will cause fatal insensibility if it be inhaled too copiously. The vapour is about 2¾ times as heavy as atmospheric air, its specific gravity being 2·695; 100 cubic inches of it will, therefore, weigh 84 specific grains. The vapour burns with a very bright light—so much so that I have no difficulty in giving a strong illuminating power to hydrogen by merely passing the gas through a tube containing a little tow moistened with benzole. This is a good example of the naphthalisation of gas; and I have here another instance of it where coal gas is passing over the benzole contained in a proper naphthaliser. You perceive the extraordinary richness of the light. Experiments have been made for the purpose of determining the value of the light for the benzole or naphtha consumed; and the results are, that every grain of the vapour taken up by a foot of common twelve-candle gas increases its light about 10 per cent. The various naphthas of commerce are more or less charged with benzole and its homologues, and they raise the illuminating power of gas from 4½ to 8 per cent. for each grain of the vapour absorbed by the gas. In the act of burning, a cubic foot of benzole vapour consumes 7½ cubic feet of oxygen, or 37½ cubic feet of air; and it produces 6 cubic feet of carbonic acid, and much aqueous vapour. The heat of the flame also is considerable. Benzole is but slightly absorbed by water, but is freely taken up by alcohol, ether, and the volatile and fixed oils. It is also, like the other rich hydrocarbons, absorbed by vulcanised tubing. The vapour is slowly condensed by chlorine and bromine in the sunlight, and compounds are formed containing six proportions of the halogens ($C_{12}H_6Cl_6$, and $C_{12}H_6Br_6$), which present a certain analogy to Dutch liquid. Sulphuric acid also absorbs the vapour, and forms conjugate acids; but the most interesting product of benzole is its substitution compound with peroxide of nitrogen, which is produced when it is brought into contact with strong nitric acid. This, indeed, is the test for benzole; so that if coal gas is passed through fuming nitric acid, as you here see, the benzole vapour is absorbed, and an oily liquid is produced, which has the odour of bitter almonds. This is easily purified by washing it with water, and finally with a weak alkaline solution. It is then called Nitrobenzole, or Essence of Mirbane. It is produced from benzole by the substitution of one proportion of peroxide of nitrogen for one of hydrogen ($C_{12}H_5NO_4$); and I may remind you that, although it is used very largely in perfumery, it is a dangerous poison; I know instances where a few drops of it have produced fatal coma. Benzole vapour is decomposed by a red heat, forming a gaseous hydrocarbon, and depositing much carbon. It is also easily condensed by cold, when it forms an ethereal liquid, which freezes into a crystalline solid at 32°, and which boils at 177° Fahr. This liquid is lighter than water, and is remarkable for its solvent power for caoutchouc, gutta-percha, and all kinds of resins and fats.

(g) The other members of the benzole series, as Toluol ($C_{14}H_8$), Xylol ($C_{16}H_{10}$), Cumol ($C_{18}H_{12}$) and, Cymol ($C_{20}H_{14}$), are no doubt also present in coal gas, for they are found in the naphtha distilled from coal tar; but as they are less volatile than benzole, they are present in smaller quantity.

(h) NAPHTHALIN ($C_{20}H_8$) is the last of the hydrocarbons to which I shall refer. It is only present in gas which has been made at high temperature, and it is invariably a secondary product of the decomposition of the richer hydrocarbons (tar, &c.) by the walls of the red-hot retort. In London, where it is the practice to work at very high temperatures, the coal gas is always charged with naphthalin, and its presence in the mains is a serious inconvenience. The vapour of naphthalin is very rich in carbon—a cubic foot of it contains five times its bulk of carbon vapour, and four times its bulk of hydrogen. The specific gravity of the vapour is 4·422, and therefore 100 cubic inches of it weigh rather more than 137 grains. It burns with a bright sooty flame, and if I heat a little of the hydrocarbon in a flask, and pass hydrogen gas through it, you will see how richly it naphthalises the gas. In the act of burning, a cubic foot of the vapour consumes twelve times its volume of oxygen, sixty times its bulk of air, and it forms 10 cubic feet of carbonic acid and aqueous vapour. Naphthalin is not absorbed by water, but it is by the volatile and fixed oils, and by naphtha and coal-tar; hence the advantage of keeping the raw gas until it is thoroughly cooled in contact with tar and ammoniacal liquor in a long hydraulic main. Hence, also, the fact that the richer qualities of gas, containing much hydrocarbon, do not deposit naphthalin; and hence, also, the use of naphtha as a remedy for naphthalin in the mains and service-pipes. The vapour of naphthalin is absorbed by chlorine and also by bromine, the products being liquids which have considerable analogy to Dutch liquid. It is also absorbed by sulphuric acid. Naphthalin is not easily decomposed by heat; it is quickly deposited by cold, forming brilliant white scales, which have a tendency to collect in the bends of pipes, and wherever there is an impediment to the easy flow of the gas. These scales are slowly volatile at ordinary temperatures, they melt at a heat of 174° Fahr., and they boil at 428°.

(To be continued.)

ACADEMY OF SCIENCES.

June 19, 1865.

A note "*On the Extraction of Sugar*," by M. Alvaro Reynoso, of Havannah, was read. The author uses acid phosphate of alumina, which he neutralises carefully with lime for clarifying the cane juice. Alumina and phosphate of lime are precipitated, and carry down effectively the colouring and nitrogenised bodies. The author has also an ingenious way of getting rid of the bulk of the water in the juice. By some process described in his memoir, but not quoted in the *Comptes Rendus*, he submits the juice to a very low temperature, and so gets a magma composed of thick syrup and little lumps of ice. He separates the syrup from these by means of a centrifugal machine, and then evaporates quickly *in vacuo*.

M. Canizzaro continued his memoir "*On the Amines of Benzoic Alcohol*." He described the method by which he obtained *dibenzylic toluidine*:—

$$N\left\{\begin{matrix}(C_7H_7)a\\(C_7H_7)b\\(C_7H_7)b\end{matrix}\right.$$

in which formula $(C_7H_7)a$ stands for cresyle, and $(C_7H_7)b$ for benzyle. The behaviour of the platinum salt of the weak alkaloid proves it to be isomeric with tertiary benzylamine. The author has made many attempts to prepare primary benzylamine free from the secondary and tertiary amines, but without success. He finds that the greater part of the chloride of benzyle is always converted into the secondary and tertiary alkaloids—a fact which connects the benzoic with the methylic series. Canizzaro intends to continue the comparative study of primary benzylamine and toluidine. Considering phenols as bodies intermediary between alcohols and acids, he regards aniline and similar alkaloids as coming between amines (those properly so called) and amides; and he hopes to show that while toluidine, in acting upon other alkaloids by incomplete substitution, disengages ammonia and replaces hydrogen by the radical cresyle $(C_7H_7)a$, benzylamine, under the same conditions, will do no such thing.

June 26.

Two communications on the woorari, or curara poison, were read. We notice first that by M. Preyer, "*On the Active Principle of Curara*." To prepare the alkaloid, the author treats the crude poison, scraped off arrows or obtained from the Indians in little clay pots, with boiling alcohol, and distils the alcohol from the solution. The residue is treated with water and filtered to separate the resin, and the filtrate is precipitated by bichloride of mercury. This precipitate contains all the curarine. It is washed, suspended in water, and decomposed by sulphuretted hydrogen; and thus hydrochlorate of curarine is obtained in solution. The purification may be effected as usual in such cases. Another way of procuring the alkaloid is to treat the aqueous solution obtained as above first with a few drops of nitric acid, and then with phosphomolybdic acid. The bulky precipitate is decomposed by hydrate of baryta, and the mixture is dried and the mass exhausted with absolute alcohol, which takes up scarcely anything but curarine. An analysis of the chloroplatinate leads to the formula $\Theta_{10}H_{15}N$ for this alkaloid, which is seen to be destitute of oxygen. There is but one other instance of a natural alkaloid not containing oxygen. Curarine may be obtained in crystals by leaving a chloroform solution to spontaneous evaporation.

The soluble salts are all crystallisable; of the insoluble the chloroplatinate alone has a crystalline appearance. The alkaloid and the soluble salts crystallise in four-sided prisms. Curarine has a persistent bitter taste, is soluble in water and alcohol in all proportions, is but slightly soluble in chloroform and amylic alcohol, and is altogether insoluble in ether, benzole, turpentine, and sulphide of carbon. Pure concentrated sulphuric acid gives to curarine a magnificent and lasting blue colour, which reaction will serve to distinguish it from strychnine. Bichromate of potash with sulphuric acid gives the same colour as with strychnia, but with curarine the colour is much more lasting. Strong nitric acid produces a purple colouration. The poison may be easily discovered in animals. Alcohol extracts it, and it may be identified by the above reactions. The author states that the poison is obtained from many plants; he has extracted it himself from the dried fruit of the *Paullinia cururu*.

The other communication was a note "*On the Physiological Effects of Curarine*," by M. Claude Bernard, who tells us that the effects of the alkaloid resemble exactly those produced by the substance from which it is obtained, but are, of course, much more intense. Like the woorari itself, it is absorbed with great difficulty by the intestinal canal, but operates with frightful energy when introduced into a wound. M. Bernard promises another communication relating to his experiments on the effects of curarine on the motor nerves.

M. H. St. Clair Deville presented a note with the promising title, "*On the Industrial Preparation of Alumina and its Compounds, and on their Industrial Applications*," but in the note he only tells us that alumina and its compounds are made in large quantities at Newcastle, and at Salindres, from Bauxite. There appears now to be no difficulty in making sulphite of alumina, which would seem to be a good defecator.

A note "*On the Employment of Biphosphate of Alumina in the Manufacture of Sugar*" was read by M. Kessler Desvignes, who claims the first use of this substance, and moreover the discovery that biphosphate of magnesia will answer just as well as a defecator of sugar juice.

A note "*On the Constitution of Hyponiobic and Tantalic Acids, and on their Association in the Mineral Kingdom*," by M. Marignac, was read. Of this, and another "*On a New Process for the Manufacture of Steel*," by M. Berard, we shall give abstracts next week.

NOTICES OF BOOKS.

Journal für Praktische Chemie. Nos. 6 and 7. 1865.

Number 6 of this Journal contains no paper of interest which has not already been noticed in the Chemical News. In No. 7 we find a paper by C. Gilbert Wheeler "*On the Mineral Ingredients in Bavarian Hops*," which gives analyses of the ashes of hops from various districts. These analyses deserve a place in a collection of such things, but we have no space for them in our pages. The principal fact learnt from them is the large proportion of potash and phosphates which hops contain, and which points to the composition of a proper manure.

The next paper is by Dr. T. Humpert "*On the Action of Concentrated Sulphuric Acid on Arseniuretted and Antimoniuretted Hydrogen, with Experiments on the Preparation of Pure Antimoniuretted Hydrogen.*" The arsenical gas passed into strong sulphuric acid gives a brown precipitate of a compound of hydrogen, sulphur, and arsenicum, which does not appear to have a constant composition, the proportion of hydrogen and sulphur increasing with the duration of the experiment. A similar compound is obtained when antimoniuretted hydrogen is passed through sulphuric acid. Sulphuretted hydrogen is evolved in both instances. To obtain the antimoniuretted hydrogen as free as possible from uncombined hydrogen the author gives the following process. He takes sodium amalgam, and places it in a flask with a tolerably concentrated solution of terchloride of antimony. The mixture froths, and antimoniuretted hydrogen escapes, but it is easily decomposed, even at the ordinary temperature. The sides of the flask quickly become coated with a thick layer of metallic antimony. This never happens when the antimonial gas is diluted with a large proportion of hydrogen. When the gas obtained as above is ignited it burns with a pale yellow flame, with the separation of thick fumes of antimonious acid.

Most of the other papers have been noticed, but we find a paper by Von Hauer "*On the Easily Fusible Cadmium Alloys,*" containing some particulars which we shall give in a table. There is also a process by Boettger for "*Etching on Zinc, and Gilding the Etched Places,*" which we give in a miscellaneous paragraph; together with other short notices of a new synthesis of formic acid, a new process for the separation of potassium, rubidium, and cæsium, and a new process for the extraction of indium from Freiberg Blende.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

1506. H. Allman, Ampthill Square, Middlesex, "Certain improvements in the manufacture of iron and steel, and in apparatus connected therewith."—Petition recorded June 1, 1865.

1573. W. E. Gedge, Wellington Street, Strand, "An improved process for penetrating or impregnating woods with various substances."—A communication from J. L. Hossard, Faubourg St. Martin, Paris.—June 9, 1865.

1582. R. A. Brooman, Fleet Street, "Improvements in kilns for firing porcelain and other ware."—A communication from F. Durand, Paris, June 10, 1865.

1586. J. E. Poynter, Glasgow, N.B., "Improvements in purifying paraffine."

1591. J. Thomas, Battersea, Surrey, "A new material to be used in the purification of heating and lighting gases."—June 12, 1865.

1595.—G. Haseltine, Southampton Buildings, Chancery Lane, "Improvements in fuses for shells for ordnance."—A communication from F. Schentel, Boston, Mass. U.S.A.

1600. C. J. Collins, Upper Thames-street, London, "A new or improved artificial fuel."

1602. T. Routledge, Ford, near Sunderland, and W. H. Richardson, Springwell, Jarrow-on-Tyne, "Improvements in the manufacture of paper and paper stock; and in the utilisation of certain waste products resulting therefrom."

1605. F. A. Laurent and J. Casthelaz, Rue Sainte Croix de la Bretonneric, Paris, "Improvements in the manufacture of phthalic acid and chloroxynaphthalic acid, and in dyeing and printing."—June 15, 1865.

Notices to Proceed.

414. W. C. Hine, Swineshead, Lincolnshire, "Improvements in stoppering bottles or other similar vessels, and measuring quantities therefrom."—Petition recorded Feb. 14, 1865.

441. W. Kerrage, Gardner's Road, Victoria Park, "An improvement in the manufacture of artificial stone for building purposes."—Feb. 16, 1865.

477. W. E. Gedge, Wellington Street, Strand, "A chemical combustible substance, and apparatus to which it is applicable." A communication from F. Stoker, Faubourg St. Martin, Paris.—Feb. 20, 1865.

500. J. Nicholas, Aspull, near Wigan, Lancashire, "Improvements in the process and apparatus for producing oil and coke from coal and slack."—Feb. 22, 1865.

511. S. Saville, Bradford, Manchester, "Improvements in separating wool from refuse, mixed fabrics, and materials."

512. W. E. Newton, Chancery Lane, "An improved mode of preparing fertilising compounds or artificial manures." A communication from G. A. Liebig, Baltimore, Maryland, U. S. A.—Feb. 23, 1865.

CORRESPONDENCE.

Continental Science.

Paris, July 2.

Any addition to the comfort of railway travelling is worthy of notice, and therefore I may mention a plan invented by M. Seris for laying the dust raised by a train. This plan, by the special recommendation of the Emperor, was tried last week on the Bordeaux line, and is said to have satisfied the engineers who witnessed the trial, but I have at present no account of M. Seris' apparatus to give.

I see also a notice of a plan of preventing boiler incrustations which I am inclined to think is not new in England, but I quote it, since it may be new to some. It consists in lining the boiler with a metallic network at some distance from the sides. The lime salts will of course be deposited upon this network, which can be easily removed, and from which the crust can be easily detached.

Dr. Carlier's fire extinguisher I think I have mentioned before, but may return to it again, since its efficacy was satisfactorily shown at the Abbe Moigno's last *soirée*. The small instrument is really nothing more than a bottle of what is in England called soda-water—that is, water saturated under pressure with carbonic acid. A stopcock lets out, and a pipe directs, the jet of gas and water to the flames, which, of course, quickly succumb. Larger instruments may be made to generate the gas within themselves by special arrangements. I do not see that this apparatus offers any advantage over Phillips's extinguisher.

I mentioned, about a year ago, the laboratory started by MM. Fremy and Chevreul, in which poor and ardent students might work, and have the advice of the two worthy Professors named, *gratis*. I am happy to say now that M. Duruy, the Minister of Instruction, has made a grant of 10,000 francs, and that M. Ménier has offered to supply the chemicals for nothing, and thus the cost of the establishment has been provided for, although the Professors still superintend it without fee. The generosity of M. Ménier does not end with the supply of the chemicals; a few students who show special aptitude for research receive pecuniary assistance from a fund which he has placed at the disposal of the Professors.

I never remember to have read before an account of the way in which butter is made in Normandy; so, thinking it may be new to others, I translate it from *Cosmos*. The cream is tied up in a canvas bag, and then buried in a hole in the ground for twenty-five hours. At the end of this time it forms a hard mass, which is broken up with a wooden pestle, whereupon the buttermilk runs away. A small quantity of water is thrown on the butter to rinse the last portions of the milk away. The pounding and the washing only occupy two minutes, and, as your readers will see, the butter is made with less labour than in any churn yet invented. In the winter, when the ground is frozen, the cream is buried in sand placed for the purpose in cellars, and a double bag is sometimes employed to make sure of getting no sand or earth into the butter.

I should have told you some time ago of a trial here which will have some interest for English pharmaceutical readers. MM. Grimault and Co. import pepsine from London, and retail it as pure English pepsine. Something, however—trade and professional jealousy, it is alleged—caused a quantity of it to be seized by the police, and it was examined by M. Roussin, who reported that the pure English pepsine was nothing but starch, and MM. Grimault and Co. were accordingly condemned. That happened some months ago, but the affair has recently come before the courts again in the shape of an appeal by the defendants, and MM. Payen and Beaudoin have now examined the pepsine, and these gentlemen report it of good quality. M. Leconte also examined and reported favourably; but the Court, apparently not altogether satisfied, has ordered a fresh examination of the pepsine seized and other pepsine from London by MM. Fremy, Mailhe, and Reveil, and after they have reported the Court will give judgment.

Some experiments have recently been made by M. Tresca on Poissant's process for decorticating wheat before it is ground into flour. The corn is first slightly moistened, and then conveyed to a cylinder in which a sort of fan revolves with great rapidity. By this action the outer skin of the grain is detached, and is subsequently separated by winnowing. The flour is reported upon by M. Payen, who says that 100 of dry corn gives 89·6 of flour, which contains a considerably larger amount of nitrogenised principles, and is therefore more nutritious, than ordinary flour, but which will not make bread so white. He considers the flour will succeed well with Dauglish's process.

Writing of corn reminds me of the prospects of harvest, and may be it will interest some of your readers to know that colza and linseed have failed nearly everywhere in this country this year.

I extract some statistics on the subject of deaths by lightning from a note by M. Boudin. It seems that during the period 1835-1863, 2238 individuals were killed in France. The most in one year was 111; the fewest, 48. Among the 880 persons killed from 1854 to 1863, only 243 were females, which will be 26·7 per cent. In England the proportion of females killed is only 21·6 per cent. In many cases, M. Boudin says, when the lightning has fallen upon a group of people of both sexes, it has only killed the males and spared the females, which, I must say, is more gallant than fair on the part of the lightning. As a set-off to this conduct, I suppose, the fluid, when it has fallen upon a flock attended by shepherds, has only killed the sheep and spared the shepherds. M. Boudin states that there have been many instances of beeches struck with lightning, and that there are at least two examples of individuals struck more than once in the course of their lives; one man, indeed, was struck three times in as many different parts of his body, and another man was struck twice in his left foot. The statistics, I may add, prove the danger of standing under trees in a storm.

On Anomalous Degrees of Water Hardness.

To the Editor of the Chemical News.

Sir,—In consequence of my not having been present at the Chemical Society when Dr. Miller read his paper on "Potable Waters," I shall feel obliged by your inserting in your journal the following remarks corroborative of the novel and interesting statement made during discussion by Dr. Voelcker, to the effect that he had analysed a water which indicated a higher degree of hardness after boiling than before. Nearly twelve months ago I was requested by a client to examine a water with reference to its applicability to ordinary domestic purposes; and after examining it microscopically, as well as estimating the amounts of organic and inorganic matter which it contained, one of my assistants endeavoured to determine its hardness, which, to his astonishment and to my own, was increased instead of diminished by boiling. Concluding that some mistake must have been made, the experiments were repeated, both by my assistant and by myself; but we always obtained the same anomalous result, no matter whether the water was boiled for an hour or for a whole day.

Several fresh preparations of soap-test were made with soap from different sources; sometimes the soap was dissolved in vinic alcohol, at others in methylated spirit. The various preparations of soap-test were graduated with solutions of chloride of calcium made and standardised at three different periods. Having taken these precautions to eliminate any error which might have been introduced into the previous experiments through the reagents employed, the attempt to ascertain the hardness of the water by means of the freshly and differently prepared soap-test was resumed. Still, it was observed that ebullition invariably caused an increase and not a diminution of the hardness of the water. Unfortunately, I am unable at present to furnish a more detailed account of the experiments above referred to, as the notes taken at the time of their being instituted are in the possession of my assistant, who is in Marburg. I trust, however, soon to receive the notes, and to be able to procure a fresh supply of the water to which they refer, in the hope that the results of a minute analysis will enable me to explain an anomaly which appears at present to be as inexplicable to Dr. Voelcker as to myself.

I am, &c.

Richard V. Tuson.

Chemical Laboratory, Royal Veterinary College, June 28.

MISCELLANEOUS.

Non-Explosive Gunpowder.—The invention of Mr. Gale, which we mentioned last week, underwent a trial at Plymouth last week in the presence of several naval and military officers, and it was shown that the powder, when treated by Mr. Gale's process, could not be ignited by an ordinary slow match, or even by a red-hot poker. The invention at first sight would appear extremely valuable, but soldiers and sailors, we expect, will be startled at the idea of going into action with non-explosive gunpowder, although the explosiveness can be easily restored in two minutes.

Destruction of Scientific Property by Fire.—On Thursday last a most calamitous fire destroyed over 30,000*l.* worth of literary and scientific property at the well known Auction-rooms of Messrs. Sotheby and Wilkinson. We are, however, happy to state that the valuable collection of photographic lenses, magic lantern slides, and the greater part of the other apparatus announced for sale in our advertising columns, is saved, having, at the time of the fire, been in the care of Mr. Highley, at 18, Green-street, Leicester-square. The sale will take place on Tuesday next, as originally fixed, but at the gallery, 21, Wellington-street.

ANSWERS TO CORRESPONDENTS.

Received.—Oxamide; Report of Manchester Scientific Students' Association for 1864.

A Constant Reader writes:—"I saw lately, but cannot lay my hands on it, an artificial, quick mode of disintegrating the leguminous portion of leaves, and retaining the woody or fibrous portion as a skeleton. Can you or one of your numerous readers furnish me with an efficient process? Also, a cotton yarn 'plated' or coated with silk (by a process analogous to plating) was, and probably is now, used in glove manufacturing (also lace), evidently not coated from an ethereal solution. Can you inform me the process?"

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On a Volumetric Analysis of Superphosphate of Lime, by GEORGE JONES, *F.C.S.*

IT has for some time been a desideratum of analytical agricultural chemists, and especially of those connected with the manufacture of artificial manures, to be enabled by a more speedy method than the one generally pursued to arrive at a correct estimation of the amount of phosphate of lime existing in a soluble state in the so-called "superphosphate." I have therefore been led to attempt a series of experiments upon a process of volumetric estimation, by the use of a standard solution of ammonia; but at the onset I experienced some difficulty in arriving at any satisfactory result in consequence of the existence of the free or uncombined sulphuric acid, which is invariably present in ordinary commercial superphosphate, it being impossible to present an alkali without precipitating the phosphate of lime.

The process I therefore adopt is the following:—Having taken 100 grains of the sample for analysis, it is first of all well mixed with about 50 grains of finely powdered litharge, and introduced along with a small quantity of distilled water into a flask, and boiled for about fifteen minutes. The whole is then made up with distilled water to 7000 grains (one deci-gallon), agitated well, and thrown upon a filter. I then take of the filtrate, by the use of a pipette, 1400 grains (200 septems) equal to 20 grains of the sample, and add thereto a little chloride of calcium solution, and 200 septems of the standard solution of ammonia; it is then made up with distilled water to a known bulk—say 2000 grains, agitated well, and filtered.

A 1000 grains pipette of the filtrate will therefore represent exactly 10 grains of the sample, and in this I now proceed to test for ammonia, added over and above that required to separate the phosphate of lime in the sample. Two equivalents of ammonia being required for every equivalent of the tribasic phosphate of lime precipitated. Thus—

$$CaO,PO_5, + 2CaCl + 2NH_4O = (CaO)_3PO_5 \text{ and } 2NH_4Cl.$$

The standard solution of ammonia I am in the habit of using contains in every septem ·01 of real ammonia, and I employ also a standard solution of hydrochloric acid, 50 septems of which require 292 of the standard ammonia for neutralisation.

In order, therefore, to estimate the excess of ammonia added to the liquid, I first add 50 septems of the standard acid, and then test with the standard ammonia, using, of course, a solution of litmus. Supposing, therefore, that 255 measures or septems of the standard ammonia are required to effect a complete neutralisation of the liquid, then say—292 − 255 = 37, and 100 (the number of measures previously added) − 37 = 63 measures of standard ammonia required to precipitate the phosphate of lime, and equal to 6·3 per cent. of real ammonia.

Therefore as—

$2(NH_3)(CaO)_3PO_5$ per cent.

34 : 155 :: 6·3 : to x = 28·72 p.c. of phosphate of lime.

By the use of the oxide of lead, the free sulphuric acid of the sample is not only neutralised but separated as insoluble sulphate, leaving the solution but slightly acid, and only from the acid phosphate. By repeated trials upon samples of known composition, I have never found this process to fail. It is both simple and accurate, and the time occupied from first to last is barely one-fourth of that required by the ordinary gravimetrical method.

June 27.

On the Easily Fusible Alloys of Cadmium, by CARL RITTER VON HAUER.*

THE alloys were made by fusing the ingredients in a covered porcelain crucible at the lowest possible temperature. After stirring with a glass rod, the fused mass was poured upon a cold metal plate, where it instantly solidified. The specific gravity and the melting point were determined after the alloy had been so melted and cooled two or three times. In the two or three fusions a partial oxidation of the metals takes place, which occasions a slight alteration in the equivalent proportions, and which it is almost impossible to avoid. The melting point was determined under hot water, and also by placing a thermometer in the fused mass without water. Under water the alloys quickly oxidise. They have also the property of becoming pasty below their proper melting point, which may lead to error in the determinations. The author's determinations were made when the alloy was really fluid.

The specific gravity of the metals experimented with were as under; the equivalent numbers are also given for the calculation of the proportions—

Cadmium	=	8·572	56
Tin	=	7·265	58
Lead	=	11·350	103·7
Bismuth	=	9·708	210

Equivalent proportions.	Specific gravity. Found.	Specific gravity. Calculated.	Difference.	Melting point.
Cd Sn Pb Bi	9·765	9·624	+0·141	68·5°C
$Cd\ Sn_2\ Pb_2\ Bi_2$	9·784	9·698	+0·086	68·5°C
$Cd_3\ Sn_4\ Pb_4\ Bi_4$	9·725	9·666	+0·059	67·5°C
$Cd_4\ Sn_5\ Pb_5\ Bi_5$	9·685	9·652	+0·033	65·5°C

The above shows that some contraction of the metals takes place, but the smallest contraction is combined with the lowest melting point.

Lipowitz states that an alloy composed of three parts by weight of Cd, 4Sn, 8Pb, and 15Bi melts at 60° C.; but the author of this paper observes that such a compound only becomes perfectly fluid at 70° C.

The melting point of an alloy of two parts Cd, 3Sn, 11Pb, and 16Bi is still higher—namely, 76·5° C.

The following mixtures had the same melting point—

$$\left.\begin{array}{ll}\text{One part by weight of} & \text{Cd, 2Sn, 3Bi}\\ \text{Two parts} \quad ,, & \text{Cd, 3Sn, 5Bi}\\ \text{One part} \quad ,, & \text{Cd, 1Sn, 2Bi}\end{array}\right\} \text{perfectly fluid at } 95°\text{C.}$$

The author adds the following determinations of specific gravities and melting points:—

Proportions.	Specific gravity. Found.	Specific gravity. Calculated.	Difference.	Melting point.
1 part Cd, 6Pb, 7Bi	10·529	10·330	+0·199	88°C
$Cd,\ Bi_2,\ Pb_3$	10·563	10·275	+0·288	89·5°C
$Cd_2,\ Bi_4,\ Pb_7$	10·732	10·341	+0·391	95°C

Synthesis of Formic Acid.

DR. R. MALY shows that formic acid is obtained under various circumstances when nascent hydrogen and carbonic acid at the moment it is set free, come together in the presence of a powerful base. A large proportion, for example, is procured when sodium amalgam acts on a solution of carbonate of ammonia. The acid is also found, but in smaller proportion, when finely granulated zinc, carbonate of zinc, and caustic potash are boiled

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* Abstract from *Journal für Prakt. Chemie*, vol. 94, p. 436.

together, in which case the nascent hydrogen simply seizes upon the carbonate of potash—

$$CO_2 + H_2 + KHO = CHKO_2 + H_2O.$$

The first reaction is, perhaps, capable of general application for the preparation of homologues of formic acid, if, instead of carbonate of ammonia, the carbonates of methylamine or ethylamine, &c., are employed.—*Journal fur Prakt. Chemie*, vol. 94, p. 442.

Researches on Acetic Fermentation,* *by M.* Pasteur.

It is a well known fact that wine, beer, and cider exposed to the air turn sour, and it was long since proved that this phenomenon was due to the alcohol of these liquids being transformed into acetic acid; but what part does the air play in this combustion, through what intermediary state of transformation does the alcohol pass?

Acetic fermentation is always produced by the exclusive influence of an organism—the *mycoderma aceti*—one of the most simple vegetables, consisting essentially of frames of articulations slightly compressed towards the middle, measuring about $\frac{1}{5000}$th of a millimetre in diameter, and double that in length. However much charged with albuminoid matter, no alcoholic liquid has ever been known to give the appearance of acetification without the presence of this mycoderm. On the contrary, if a trace of the mycoderm is spread on the surface of an albuminoid liquid, alcoholic or slightly acid, it is immediately seen to develope, extend like a veil over the surface, and by a correlative action the atmospheric oxygen in contact with the liquid disappears and the alcohol acetifies. It is not essential for the liquid to contain albuminoid matters; provided the mycoderm finds there besides the alcohol a small quantity of alkaline and earthy phosphates, it will live and its action be the same as before; and this identity proves that the albuminoids which have been employed were merely nourishment for the ferment, and not the ferment itself.

If in the actual process of vinegar making, acetification takes place without the previous spreading of the mycoderm, it must have been without the knowledge of the experimenter; it is this organism which forms the gelatinous mass which was formerly, with a vague idea of the truth, called mother of vinegar; it is this which by spreading over large surfaces of the beechwood chips used in the German process produces acetification. By pouring an alcoholic liquid on these chips, well washed and scoured, and thus deprived of the ferment, no trace of vinegar is obtained; but, the circumstances being favourable, acetification is produced by depositing a little of the mycoderm on the surface of the chips, where it rapidly developes.

While alcohol is present the small vegetable produces acetic acid; but what happens if the alcohol is wanting? M. Pasteur shows that the vegetable can in this case bring its burning action to bear on the acetic acid itself, and reduce it to the state of water and carbonic acid. This effect seems to be produced only when no alcohol is present, when there is alcohol the combustion is effected by preference on it.

Such is the action of the mycoderm under the ordinary conditions; but it sometimes alters, and having no longer the same appearance or the same consistence, its action is different. It is then incapable of effecting the combustion of the alcohol to the acetic stage, and gives intermediary products with a suffocating odour, and causing the eyes to water, and which have already been obtained in the oxidation of alcohol and ether by platinum black. This black, under other conditions, will give acetic acid, and here between platinum black and *mycoderma vini* there is a resemblance of effects from which it would be unsafe to infer a resemblance of causes. The only inference to be drawn is that both are means of transporting the oxygen of the air on to certain combustible matters.

For the production of acetification it is necessary that the mycoderm should be at the surface of the liquid; the process is arrested by submersion, and only recommences on the formation of a fresh film on the surface.

The absorption of oxygen by this film is complete, and not a trace of this gas enters the liquid through it. When there is, as in Orleans' vinegar, a large quantity of small eels—animalculi needing air to support life—a curious contest takes place between them and the mycoderm, the latter tending to engross the whole of the surface, while the former combine all their efforts to submerge it and expose the liquid in which they live to free contact with the air.

The complete study of the manner in which this ferment acts and of the last interesting particulars will, perhaps, cause some progress to be made in the industrial preparation of vinegar; but the study of possible improvements must be left to the manufacturers.

THE
DUBLIN INTERNATIONAL EXHIBITION.

By Chas. R. C. Tichborne, *F.C.S., F.R.G.S.I., &c.*

(*Specially Reported for the* Chemical News.)

(*Continued from page* 6.)

Two complaints have been forwarded to the writer that he has passed over, in silence, cases in the Exhibition which deserved notice. The writer acknowledges, in a degree, the justice of the complaints, but then it must be taken into consideration that it would be perfectly impossible to enter into particulars of every case exhibited in a limited number of articles. Nor would such articles possess interest for the readers of this journal. The plan followed out has been to dwell upon exhibitors who would best represent a class, also to notice anything new which might occur amongst the others. It has been the endeavour of the author, as far as possible, not to touch upon a beaten track, but to place before the readers any little novelties which have been brought forward by this Exhibition, and will, therefore, not be found in any other report. At the conclusion a complete list of the chemical exhibitors will be given, this being all that space will permit.

Perfumery.—The perfumery department is well represented by Piesse and Lubin, Rimmel, and other well-known firms. The first-named house shows some very novel scents, but scents are so much a matter of taste that, to carry out Dr. Piesse's theory, what one person may consider a very *recherché* odour another may consider a regular flat 7th unresolved, but he may easily resolve the discordant feeling by turning to one which accords with his ideas. Dr. Piesse has many novel ideas upon the subject of perfumery, and one of the most important of them he submitted to the Royal Horticultural Society some short time since. The commercial importance of the cultivation of flowers for perfumery may be inferred from the following statistics:—The entire process of growing flowers for the process of *enfleurage* is carried on in the valley of the Var, in the extreme south

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* *Annales de l'Ecole Normale*, I.

of France, bordering upon Italy—that is to say, from Nice to Cannes and rising to Grassa. This area comprises about 115,200 acres. All flowers, the olive and the vine, thrive here to perfection. The flower harvest of the district of Cannes alone gives the following annual supply:—Orange blossoms, 1,475,000 lbs.; roses, 530,000 lbs.; jasmine, 100,000 lbs; violets, 75,000 lbs.; tuberose, 24,000 lbs.; jonquils, 5000 lbs. This does not include Nice and other districts. The value of these flowers is from 2d. to 2s. per pound. Now, says Dr. Piesse, no tree is so profitable to the flower farmer as the orange, and emigrants to any of our warm colonies should make a note of this, and fix on their memory that the leaves of the orange yield an otto worth 3s. an ounce, that the flowers yield an otto worth 10s. an ounce, that the blossom also yields by *enfleurage* a fat worth 8s. per pound, that the rind of the fruit yields an otto worth 12s. to 16s. per pound. There is a fine orangery near Sydney, the property of Richard Hill, Esq., so that we may soon expect in the markets of Britain the produce of this plant from one of our colonies. Queensland, Western Australia, Southern New Zealand, and Jamaica may take the hint, according to Dr. Piesse.

There is nothing new in the way of artificial flavouring essences. A few specimens of essence of pine (butyric æther), jargonelle pears (acetate of oxide of amyl).

Paraffine, Wax, Illuminating Oil, &c.—There are certain names which are intimately connected with specialities. We find two such, represented by two of the finest cases in the Exhibition; placed one each side of the nave, they stand like another Gog and Magog.

Paraffine is now extensively manufactured, and the process of palm oil distillation will soon be equally disseminated. But Mr. Young's name is so associated with the former, and Price's with the latter, that one cannot pass over their cases without paying a passing tribute.

Paraffine has been practically separated from resin, petroleum, fossil oils, peat, and coal. The last two have been the most prolific source of this beautiful product, whilst Mr. Young, by his slow process of distillation direct from coal, has certainly brought the method of manufacturing paraffine to the greatest perfection. When the Exhibition opened Mr. Young's case contained magnificent specimens of castings in paraffine. These included a colossal bust of Sir Walter Scott and sundry statuettes. Now, these strikingly illustrate the applicability of this "solid gas," as Liebig calls it, to the moulding of candles, the contraction of the melted paraffine being comparatively very slight, but sufficient to make it leave the moulds efficiently. It is, in fact, more suited to this kind of work than even spermaceti, wax, or stearine. There can be no doubt that before long the paraffine will be the candle *par excellence.* Its beautiful appearance, clear light, and cleanliness will no doubt in time establish its value. A strange result was produced in Mr. Young's case during the late fine weather. The sun's rays were so strong that most of the figures were partially melted, and found on one occasion in anything but a perpendicular position. This will give us a decided impression of the temperature of such buildings on a fine day, when we take into consideration the fact that pure paraffine melts at 60° C., according to Dr. Hofmann's report. This was procured by the following process, which is the one ordinarily used:—The mass of crude paraffine is subjected to hydraulic pressure, first in the cold and afterwards with the application of heat. The object of this last operation is to remove all hydrocarbons having a lower melting point than 40° C. For this purpose there are placed in the horizontal presses between each pair of paraffin cakes hollow plates, through which water of 32°—40° C. is made to flow. In this way the hydrocarbons in question are fused and squeezed out. The pressed paraffine is now heated to 150° C. either over a fire or by means of steam, and the melted mass is mixed with 2 per cent. of concentrated sulphuric acid, by means of which all the hydrocarbons not being paraffine are carbonised. It is then carefully washed with hot water, and after cooling is mixed with the best colourless photogen (light mineral oil), and introduced into iron jacket cylinders, in which it can be kept warm, and where it is filtered through animal charcoal. By treatment with superheated steam the photogen is again completely separated from the paraffine. The paraffine manufactured in this manner is said not to bend when exposed to a temperature of 30° C.

In spite of the care expended upon the purification of paraffine, it is rarely that two samples can be procured so as to have a constant melting point. In many of the cases beautiful specimens of coloured paraffine candles are shown, and we believe that the coal-tar colours have been used for this purpose. It has lately been pointed out that the fatty acids form salts with rosaniline of a intense tinctorial power. We can well understand that these fatty salts would be applicable to the colouring of candles, palmitic, stearic, and oleic acids form salts with rosaniline, and the writer has verified the reaction with chrysaniline. He has no doubt that all the colours could be used for this purpose by varying the manipulations. From the small quantity requisite, and the organic nature of the pigments, the advantage in reference to its non-interference with the illuminating effects must be evident. The pigments in ordinary use—viz., verdigris, vermillion, chrome yellow, &c., are certainly not very desirable in this respect.

In connexion with the present case, we must mention the interesting case of Messrs. J. and C. Field, of Lambeth, one of the original manufacturers of paraffine candles. They also invented the self-fitting candles. But a still more important invention seems to have originated with them—viz., the plaited wicks, which are now universally used throughout the world. The well-known night-lights seem to have been their invention, the first of them being made of wax. As this is essentially an age of art, we are not surprised to find that even candles are made to bear designs upon their surface—although they are things like flowers, made only to look gay for a brief space. Some of them, though most gaudy, are wanting in taste; but, on the other hand, there is a style of decoration, generally in the floral way, and painted in very subdued tones, which is beautiful in the extreme. The paraffine is particularly suited for this kind of decoration, as it presents such a pure translucent background to the colours. There are some very fine specimens exhibited by Messrs. Taylor and Co., Leith, and Rathborne and Co., Dublin; the latter firm being, we believe, the only manufacturers of paraffine candles in Ireland. The process by which this effect is produced is simply a matter of transferring the painting, which is first executed upon rice-paper in gum and colours, to the surface of the candle. Messrs. Rathborno and Co. are also bleachers of wax, and exhibit a specimen of pure wax. This article, it is almost needless to say, would be almost unsaleable as a commercial product in the present day. The ordinary white wax always contains spermaceti, or some other substance which gives it its white translucent appearance.

We think we are right in stating that Price's Patent

Candle Company at one time worked Rangoon naphtha for paraffine; but what they are more celebrated for is their process of distilling palm and other oil by which that substance is split up into its components, glycerine and the fatty acids, the latter being used in their candles. It was this firm that placed pure glycerine within the reach of the commercial public; and we will even go further, and say that, until they produced it, that substance was unknown. It is really wonderful to find the number of useful manufactures to which it has been since applied.

Lately distilled glycerine has been found in the market at various prices, some of it very good, and some equally bad. A German specimen which has come into the possession of the writer has evidently been decolorised with chlorine. For most of the applications of glycerine this would be very undesirable, whilst very few samples will be found to have the specific gravity of Price's.

	Sp. gr. at 60° F.
Price's glycerine, concentrated upon a water bath	1·256
Price's glycerine, as met with in commerce	1·253
German glycerine, very firm and fine specimen	1·173
Common German glycerine	1·239
English plaister glycerine	1·120

It is even necessary, therefore, to take the specific gravity into consideration in connexion with the price. One vile specimen, said to have come from the Continent, was examined by Mr. Draper, and found to consist of nothing but uncrystallisable sugar. This firm has in their case candles, coro-oleine, coro-stearine, specimens of wood shavings used in night-lights, in order to escape the paper duty, 160 cuts to the inch board, lubricating oil from Rangoon, petroleum, palm nuts, palmitic acid, &c.

Mr. Hutchinson exhibits some fine specimens of carbonate and bicarbonate of sodium—so-called crystals of bicarbonate of soda. Of course it is understood that they are pseudomorphous, retaining the rhombic form of carbonate of sodium; they are very beautiful and interesting objects; also some very fine specimens of caustic soda are exhibited.

PROCEEDINGS OF SOCIETIES.

ON THE PRESENT STATE OF THE CHEMISTRY OF GAS LIGHTING.

By Henry Letheby, *Esq., M.B., &c.*

Delivered at Birmingham, before the Society of Gas Engineers.

(*Continued from page* 10.)

And now, in reviewing the facts which have been brought before us in an examination of the several hydrocarbons found in coal gas, the conclusions are—

1. That they belong to different groups, or series of compounds, in which the proportion of carbon and hydrogen rise by successive increments of 2 + 2, and that the amount of hydrogen in them progressively decreases.

In the Marsh gas series, for example, the proportion of hydrogen is always two more than the carbon, thus:—Marsh gas, or Methyl-hydride, C_2H_4; Ethyl-hydride, C_4H_6; Propyl-hydride, C_6H_8; Butyl-hydride, C_8H_{10}; Amyl-hydride, $C_{10}H_{12}$, &c., all of which are found in the petroleums.

In the next series, the Alcohol radicals, which may or may not be present in coal gas, the praportion of hydrogen is only one more than the carbon, thus:—Methyl, C_2H_3; Ethyl, C_4H_5; Propyl, C_6H_7; Butyl, C_8H_9; Amyl, $C_{10}H_{11}$, &c.

In the third series, which are the chief constituents of coal gas, the Olefiant gas series, the proportions of carbon and hydrogen are equal, thus:—Methylene, C_2H_2; Ethylene, C_4H_4; Propylene, C_6H_6; Butylene, $C\,H_8$; Amylene, $C_{10}H_{10}$; Capryolene, $C_{12}H_{12}$, &c.

In the next compound, Acetylene C_4H_2, it is two proportions less; and in the Benzol series it is six proportions less, thus:—Benzol, $C_{12}H_6$; Toluol, $C_{14}H_8$; Xylol, $C_{16}H_{10}$; Cumol, $C_{18}H_{12}$; Cymol, $C_{20}H_{12}$, &c.

And, lastly, in the Napthalin series it is at least twelve proportions less.

2. We notice that the illuminating power of these hydrocarbons rises in proportion to the amount of carbon contained in a given volume of them—marsh gas being the weakest and naphthalin the strongest.

3. We perceive that their weight, or specific gravity, rises with their photometrical value—marsh gas being only about half as heavy as atmospheric air (0·5531), and naphthalin four and a-half times (4·42); so that, if accidental impurities were not present in coal gas, the specific gravity of it would furnish a good indication of its quality.

4. We remark that all the richer hydrocarbons, excepting acetylene and naphthalin, are easily decomposed by heat, carbon being deposited, and a weaker quality of gas—generally marsh gas—produced. It is manifest, therefore, that these important constituents of coal gas will not bear contact with the red-hot walls of the retorts; and the practical conclusion from it is that they should be swept out of the retorts as quickly as possible, and that the temperature of the retorts, especially of the upper parts, should be as low as possible; in fact, the destruction of these bodies is not by the temperature to which the coals are subjected, but by the heat of the upper parts of the retorts upon which the distilled gases and vapours impinge.

5. We have observed that, with one exception (marsh gas), all these hydrocarbons are freely absorbed by chlorine, bromine, and strong sulphuric acid; and that in each case a very similar set of compounds is formed, Dutch liquor being the homologue of the haloid compounds. This indicates the difficulty of determining the photometrical value of gas by the amount of condensation with chlorine or bromine; for by such a process we have no knowledge of the particular hydrocarbon condensed. In my own experiments I find that the condensation may be very different, even when the gases examined have the same illuminating power; and, conversely, we may have the same amount of condensation for gases of very different illuminating powers: the number, therefore, 3·25, which is sometimes taken as the co-efficient of power, is altogether unreliable.

6. We notice that all the richer and more condensible hydrocarbons are condensable by cold, and, therefore, that gas should not be subjected to a cold of 32°, or even much below 50° Fahr.

7. It is a fact that water has little or no influence on any of the hydrocarbons, except acetylene; and as this exists in gas only to a very small extent, there is little or no danger from a copious washing of the gas before it goes to the purifiers.

8. It is worthy of remark that the hydrocarbons are freely absorbed by oils, and by vulcanised india-rubber tubing. This circumstance should be taken into account in testing the illuminating power of gas, for I find that a flexible tube of about 30 feet in length will reduce the power of a weak gas to the extent of nearly 25 per cent.

9. It is not an unimportant fact that these hydrocarbons consume very different proportions of oxygen, and, therefore, vitiate very different proportions of atmospheric air; and, again, the explosivo power of coal gas, when mixed with air, is much affected by the proportions of the richer

hydrocarbons present. The explosive power of hydrogen, when mixed with its proper proportion of oxygen and fired, is about 26⅓ atmospheres; of marsh gas, about 38 atmosphères; of olefiant gas, nearly 44½ atmospheres; of propylene, about 66 atmospheres; and butylene, nearly 89 atmospheres; common coal gas, in exploding with its proper proportion of oxygen, exerts a pressure of about 34 atmospheres on the walls of the containing-chamber; and the proportion of air which is capable of giving the strongest explosion is 6½ times the bulk of the gas.

In order that the leading properties of the several combustible constituents of coal gas may be seen at a glance, I will direct your attention to this diagram, where I have tabulated not only the known constituents of gas, but also some of their allies, as the alcohol radicals, as they are sometimes called, which occupy an intermediate place between the marsh gas and the olefiant gas series of compounds. You will here see how in each series the proportions of carbon and hydrogen progressively increase in the same volume of gas or vapour, and how also the specific gravity of the gas likewise increases; and so also does its illuminating power, and its vitiating effect on the atmosphere. In this last respect I have considered that 4 per cent. of carbonic acid in the air renders it irrespirable. You will also note the proportions in which the several compounds are absorbed by water.

Constituents of Coal Gas and their Allies.

Name.		Symbol or Formula	1 Volume contains		Specific Gravity of Gas or Vapour.	Weight of a Cubic Foot (Grains).	Volumes Soluble in 100 Vols. of Water.	Volumes of Oxygen to burn.	Product of 1 Volume.		Volumes of Air vitiated by 1 Vol.
			Vol. C.	Vol. H.					Vol. CO_2.	Vol. HO.	
	Hydrogen	H	0·0	1·0	0·069	37·1	1·93	0·5	0	1	2·5
	Carbonic oxide	$C\ O$	0·5	0·5(0)	0·967	519·2	2·43	0·5	1	0	27·5
Marsh gas series	Methyl-hydride	$C_2\ H_4$	0·5	2·0	0·553	296·9	3·91	2·0	1	2	35·0
	Ethyl-hydride	$C_4\ H_6$	1·0	3·0	1·037	556·8	0·50	3·5	2	3	67·5
	Propyl-hydride	$C_6\ H_8$	1·5	4·0	1·520	816·2	0·00	5·0	3	4	100·0
	Butyl-hydride	$C_8\ H_{10}$	2·0	5·0	2·004	1076·1	0·00	6·5	4	5	132·5
	Amyl-hydride	$C_{10}H_{12}$	2·5	6·0	2·488	1336·0	0·00	8·0	5	6	165·0
Alcohol radicals	Methyl	$C_2\ H_3$	1·0	3·0	1·037	556·8	5·08	3·5	2	3	67·5
	Ethyl	$C_4\ H_5$	2·0	5·0	2·004	1076·1	2·15	6·5	4	5	130·0
	Propyl	$C_6\ H_7$	3·0	7·0	2·971	1595·3	0·00	9·5	6	7	197·5
	Butyl	$C_8\ H_9$	4·0	9·0	3·939	2115·1	0·00	12·5	8	9	262·5
	Amyl	$C_{10}H_{11}$	5·0	11·0	4·906	2634·3	0·00	15·5	10	11	327·5
Olefiant gas series	Methylene	$C_2\ H_2$	0·5	1·0	0·485	260·4	0·00	1·5	1	1	32·5
	Ethylene	$C_4\ H_4$	1·0	2·0	0·970	520·8	16·15	3·0	2	2	65·0
	Propylene	$C_6\ H_6$	1·5	3·0	1·455	781·2	0·00	4·5	3	3	97·5
	Butylene	$C_8\ H_8$	2·0	4·0	1·940	1041·6	0·25	6·0	4	4	130·0
	Amylene	$C_{10}H_{10}$	2·5	5·0	2·425	1302·0	0·00	7·5	5	5	162·5
	Acetyline	$C_4\ H_2$	1·0	1·0	0·898	482·2	100·00	2·5	2	1	62·5
Benzole series	Benzole	$C_{12}H_9$	3·0	3·0	2·695	1471·3	0·80	7·5	6	3	187·5
	Toluole	$C_{14}H_8$	3·5	4·0	3·179	1707·0	0·00	9·0	7	4	220·0
	Xylole	$C_{16}H_{10}$	4·0	5·0	3·662	1996·3	0·00	10·5	8	5	252·5
	Cumole	$C_{18}H_{12}$	4·5	6·0	4·146	2226·2	0·00	12·0	9	6	215·0
	Cymole	$C_{20}H_{14}$	5·0	7·0	4·630	2486·1	0·00	13·5	10	7	317·5
	Napthalin	$C_{20}H_8$	5·0	4·0	4·422	2374·4	0·00	12·0	10	4	311·0

3. *Impurities, or Objectionable Constituents of Coal Gas.*

These are Carbonic Acid, Oxygen, Nitrogen, Ammonia, Sulphide of Carbon, Sulpho-hydrocarbons, Sulphuretted Hydrogen, Cyanogen, and Aqueous Vapour.

(a) Carbonic Acid (CO_2).—This gas is always produced in the retorts during the early stages of the carbonisation of coal; and if the coals are very wet the quantity of the gas is increased by the action of the red-hot coke on the aqueous vapour—hydrogen and carbonic acid being produced. The amount of the gas is also augmented if the exhauster draws air through the pores or fissures of clay retorts. This gas consists of carbon and oxygen in such proportions that a volume of it contains half a volume of carbon vapour and a volume of oxygen. The gas is heavier than air in the proportion of 1·5202 to 1; and it is not only incombustible, but it also checks the combustion of other gases. A taper is immediately extinguished in air containing 14 per cent. of carbonic acid; and it burns very dimly, and only for a short time, in air containing 12 per cent. of the gas. Even detonating gas (a mixture of oxygen and hydrogen in proper proportions) will not explode when it is mixed with 2·89, or a little less than three times its volume, of carbonic acid. The effect of the gas in reducing the illuminating power of coal gas is very marked. You will observe this in the experiment which I will now make. Here is the standard flame of the burning gas, and when I introduce about 3 per cent. of carbonic acid into the gas, you will notice how seriously the power of the light and the volume of the flame are diminished. My own experiments have led me to the conclusion that 1 per cent. of carbonic acid in common coal gas will diminish the light about 5 per cent.; and that 2 per cent. of it in gas will reduce the power of 14-candle gas to about 12·5. In the case of the jet, a mixture of 5 per cent. carbonic acid reduces the light to half. It is, therefore, a serious impurity, and should always be removed from gas. This is easily accomplished, for carbonic acid is soluble at common temperatures, in its own volume of water, and alkalies absorb it very freely. Caustic lime, for example, will take up nearly its own weight of the gas; and, as I have already said, the purification should always be so managed that lime is the last agent through which the gas passes on its way to the holders.

Another objectionable property of carbonic acid is its action on the animal system. In its concentrated state the gas is absolutely irrespirable, and it kills immediately by causing spasm of the glottis. Even when it is diluted with air to the extent of 1 in 10, it quickly produces insensibility, and an atmosphere containing only 4 per cent. of it is dangerous. This is the proportion found in the air expired from the lungs; and therefore I have used it in the diagram just referred to as the proportion which renders air irrespirable. As little, indeed, as 2 per cent. of the gas in air will cause distress, as headache, and great depression of the vital powers; and no doubt the discomfort which arises from the too liberal use of gas in badly-ventilated rooms is in great part due to the carbonic acid produced by the burning gas. I have found by experiment that a small gas stove in one of Phillips's baths, in my own bath-room, will charge the air so oppressively with carbonic acid as to render it almost irrespirable. On one occasion I detected 3·5 per cent. of carbonic acid in the air of the room; and I need not say that this is a dangerous quantity. It is therefore advisable that the products of the combustion of gas, when it is burned in large quantity, should be carried out of the room; and this precaution is applicable to every illuminating agent which vitiates the atmosphere, as you will see from this diagram:—

Relative Values of Illuminating Agents,

In respect of their Heating and Vitiating Effects on the Atmosphere, when burning, so as to give the Light of 12 Standard Sperm Candles.

	Pounds of Water Heated 1° Fahrenheit.	Oxygen Consumed Cub. Ft.	Carbonic Acid Produced Cub. Ft.	Air Vitiated. Cub. Ft.
Cannel gas .	1950	3·30	2·01	50·2
Common do. .	2786	5·45	3·21	80·2
Sperm oil . .	2335	4·75	3·33	83·3
Benzole . . .	2326	4·46	3·54	88·5
Paraffin . . .	3619	6·81	4·50	112·5
Camphine . .	3251	6·65	4·77	119·2
Sperm candles .	3517	7·57	5·27	131·7
Wax candles .	3831	8·41	5·90	149·5
Stearic candles.	3747	8·82	6·25	156·2
Tallow candles.	5054	12·06	8·73	218·3

The mode of discovering the presence of carbonic acid in coal gas is very simple; for if the gas is passed through a little lime water it will render it milky, or if shaken with a solution of potash the amount of absorption indicates the proportion present.

(b) Oxygen (O).—This comes from the too active operation of the exhauster, and the drawing in of air through the retorts. The mischievous influence of this gas on the illuminating power of coal gas will be seen from this experiment, where I will pass about 6 per cent. of air into the burning gas, and you will notice how seriously the light of the flame is destroyed. It has fallen, in fact, to about half its original power. The following are the proportions of light lost by different amounts of air in gas, supposing the light to be 100:—

	Light.
2 per cent. of air in gas	90
5 " "	70
7 " "	52
10 " "	34
20 " "	12
40 " "	1
50 " "	0

The test for the presence of oxygen in coal gas is a little pyrogallic acid; and in operating you will proceed thus: First, agitate a known volume of the gas with a strong solution of potash, and observe the loss of volume—that is, due to carbonic acid; then put into the potash solution, which is still in contact with the gas, a little pyrogallic acid, and again agitate. If oxygen be present, the solution will acquire a brown colour, and the further diminution of volume is due to the absorption of oxygen. I ought to say that the gas is heavier than air in the proportion of 1 to 1·1056; and 100 volumes of water will absorb about 2·99 volumes of it at common temperatures.

(c) Nitrogen (N) is another impurity derived from the air by the action of the exhauster. The gas has no very marked influence on the luminosity of the flame, beyond this—that, in expanding under the influence of the temperature of the flame, it cools it somewhat by abstracting heat; and another objection to it is its power of forming nitric acid when it burns with the gas. There is no ready test for the discovery of this gas. It is a little lighter than air—its specific gravity being 0·9713; and it is but feebly soluble in water—100 volumes taking up about 1·48 volume of the gas.

(d) Ammonia (NH_3).—This is a product of the carbonisation of the coal, and it may exist in the gas in a free state, or combined with carbonic acid. A volume of the gas consists of half a volume of nitrogen and one and a half volume of hydrogen. Its specific gravity is 0·5896, and its objectionable properties are that it attacks copper and brass fittings, and that in burning with the gas it forms nitric acid; and that it is a purveyor of naphthalin, and other heavy and fœtid hydrocarbons in coal gas. The gas is readily absorbed by water; at common temperatures water will take up about 727 times its volume of the gas. It is also absorbed by dilute acids, and by many neutral salts. There is, therefore, no difficulty in removing it from gas. The test for it is moistened turmeric paper, which becomes red in less than a minute when the gas contains no more than 1 grain of ammonia in 100 cubic feet.

(e) Bisulphide of Carbon (CS_2).—This compound is almost invariably present in coal gas, and it is no doubt formed in the latter stages of the distillation when the temperature is high, and when the sulphur liberated from the pyrites comes into contact with the incandescent coke. The vapour of bisulphide of carbon is very heavy—its specific gravity being about 2·6447; and its volatility is such that it cannot be condensed from gas by cold. It is not soluble in water, but it is freely dissolved by alcohol and ether, and by the volatile and fixed oils. When the vapour of sulphide of carbon is mixed with aqueous vapour, and passed through a red-hot tube, it is decomposed, and, by a mutual interchange of elements, the sulphur is converted into sulphuretted hydrogen, and the carbon into carbonic acid. It is also decomposed when it is passed over red-hot lime, or baryta, and when it is brought into contact with the peroxides of the metals—as of iron, manganese, and tin, in an ignited state; and, lastly, I may say that it is absorbed by sulphide of ammonium, and that it is decomposed by an alcoholic or aqueous solution of the alkalies in the presence of a salt of lead. All these reactions have been made the basis of inventions for the removal of bisulphide of carbon from coal gas. Thus the solution of it in oil is the property taken advantage of in the process of Schomberg, who proposes that the gas should be washed with oil. The decomposition of it at a red heat by steam is the recent suggestion of Mr. Lewis Thompson. The decomposition by ignited lime is the process of Mr. Bowditch; and its solution in ammoniacal liquor is the plan proposed by your president. The absorption of it by an alcoholic solution of potash or soda is the patent of Dr. Stenhouse; and the decomposition of it by passing it through a solution of oxide of lead in soda is the process of Dr. Angus Smith. And, although none of these processes have been found to be absolutely effective in practice, yet they are all more or less so; and they point to the importance of removing, as far as possible, this objectionable impurity from coal gas: for, in the act of burning, the sulphur of the bisulphide is converted into sulphurous acid, and this by further oxidation, in the presence of moisture, soon becomes sulphuric.

The tests for the discovery of this compound in coal gas are very numerous, and are founded on the reactions before mentioned. Dr. E. Herzog, for example, recommends that the gas should be passed through a strong solution of ammonia in alcohol, to which a few drops of sugar of lead has been added; and, if the bisulphide be present, it will give an orange-red precipitate. Or the gas may be passed into an alcoholic solution of potash, which freely absorbs the bisulphide, and converts it into xanthate of potash, which produces, with a solution of copper, the characteristic yellow precipitate of xanthate of copper; and, when boiled with a little sugar of lead, it produces a brown or black precipitate. Dr. Hofmann's test for bisulphide is to pass the gas through an ethereal solution of triethylphosphine, which forms with it a compound that crystallises in the form of little prisms of a splendid red colour. But the easiest mode of discovering its presence in coal gas, and also of determining its amount, is to burn the gas at the rate of 1 foot an hour from a Leslie burner, and to carry the products of combustion together with ammonia, into a glass cylinder, where they are condensed, and where the sulphur is afterwards found as sulphate of ammonia. The proportion of sulphur thus discoverable in coal gas ranges from about 4 grains per 100 cubic feet in the better kinds of cannel gas, to about 40 grains in the worse varieties of common London gas.

(f) Sulpho-hydrocarbons.—The nature of these compounds has not been determined, but there is good reason for concluding that sulphur exists in coal gas in other forms than as sulphuretted hydrogen and bisulphide of carbon. As in the last case, however, the sulphur, whatever may be its form of combination, is discoverable by the combustion process.

(g) Sulphuretted Hydrogen (HS) is but rarely present in coal gas, and its proportion is never large. The test which is commonly used for its detection—namely, a little sugar of lead on paper—will discover the millionth part of this impurity.

(h) Cyanogen (C_2N).—This compound is found in but very small proportion in coal-gas, although its presence is always indicated by the existence of sulpho-cyanogen in the water of the meters. It is a constant product of the carbonisation of coals, and its proportion increases with the amount of nitrogen in the coal, and with the temperature at which they are distilled. Nearly the whole of the cyanogen is condensed in the hydraulic main, where it unites with sulphuretted hydrogen and ammonia, and forms sulpho-cyanide of ammonium—the compound which gives the rich blood-red colour to the persalts of iron. But a trace of the gas escapes condensation, and passes into the mains, where it forms, in like manner, the sulpho-cyanide. In its pure state, cyanogen is a colourless gas, with a very peculiar odour, and it is a deadly poison. It consists of a volume of nitrogen and a volume of carbon vapour condensed into one volume, and its specific gravity is 1·8006. It burns with a pale rose-coloured flame, and forms twice its own volume of carbonic acid. It is not easily absorbed by water, but it is more freely taken up by alcohol, ether, and volatile oils; and it is readily absorbed by alkalies and alkaline sulphides. It is this compound which, uniting with iron, forms Prussian blue, and so gives the blue and bluish-green colour to the spent lime (blue billy). There is no ready test for the recognition of the very small proportion of cyanogen contained in coal-gas; but if a large volume of gas be passed through a tube containing flints moistened with an alkali, and the flints be acidified, they will acquire a blue colour if iron be present, in consequence of the formation of Prussian blue; or the liquid may be treated with a little sulphate of iron, and then acidified with sulphuric acid, when it will present a blue colour.

(i) The last impurity in coal gas is Aqueous Vapour (HO), the proportion of which varies with the temperature. It is rarely less than 200 grains, or about 1037 cubic inches, in 100 cubic feet of gas, and it rarely exceeds 600 grains, or 3111 cubic inches, in the 100 feet. The influence of this impurity is not very striking, although the tendency of it is to reduce the luminosity of the flame by decomposing the hydrocarbons in the burning gas.

There is one property of aqueous vapour which has not been sufficiently noticed, but which is the chief cause of the heat and discomfort so often experienced in a room where gas is largely consumed. The property which I allude to is that of absorbing the radiant heat from the burning gas, and so, by its distribution through the air, elevating the temperature of the room. When much aqueous vapour exists in the atmosphere—and, as you will see by the table already referred to, there is much of it produced by burning gas—there is not only an elevation of temperature by the absorption of the radiant heat from the gas-flame, but there is also a check to the natural evaporation from the surface of our bodies, and the perspiration collects as visible moisture. We, therefore, feel hot and uncomfortable. This is another reason why the products of the combustion of gas should be removed as speedily as possible from the room in which they are produced.

And now I have but little time left for the discussion of the second part of my subject—namely, the means to be used for the combustion of gas so as to secure the fullest amount of heat or light. I will, however, direct your attention to two or three experiments, which will illustrate the fact that the light of a flame is dependent on the number of minute solid particles within it, and on the intensity and duration of their ignition. On the one hand, if I take hydrogen gas, which contains no solid particles, and which produces no solid particles in the act of burning, it will give me a flame of no appreciable luminosity; but I can at once give light to the flame by sifting solid matter, as magnesia or lime, into it; or by dosing it with benzole, or any other volatile hydrocarbon which is rich in carbon. Again, I have here the oxyhydrogen flame; it is barely perceptible until I direct it on a piece of lime, and then the solid particles of the lime become intensely ignited, and a vivid light is the result.

On the other hand, if I destroy the solid particles of a bright flame its luminosity disappears. Let me blow air into gas, as I can easily do with this double jet, and you will perceive how completely the light is destroyed; but the temperature of the flame is considerably increased, for I can now easily melt and burn iron with it.

The difference, therefore, which we perceive in the light evolved by different flames is entirely dependent on the different proportions of solid particles contained in them. This spirit of wine and this sulphur burn with little or no light; but this phosphorus, and this magnesium burn with a vivid light; and the results in the latter case are due to the production of solid particles (phosphoric acid and magnesia), which are intensely heated. So again, the electric light is a stream of heated particles of carbon flowing from pole to pole. I have not time to enter on the question of the relative luminosity of these several flames, but you will perceive they are all very great; and the consideration which flows from it is, that when we wish to obtain the maximum amount of light from any quality of gas, the object should be to detain the particles of carbon in an ignited state as long as possible. This can only be accomplished by a proper adaptation of the supply of air; for if the supply be too great, the particles of carbon are too quickly burnt, and if it be too little, they escape unconsumed as smoke, and the temperature of the flame is reduced. You will see, therefore, that there is no one burner which is suited for every quality of gas, unless, indeed, the supply of it to the burner is regulated. I have here a number of contrivances which have been invented for the purpose of increasing the illuminating power of a poor gas; but they are all contrivances for checking the supply of air to the flame, or for diminishing the too rapid outflow of the gas. I regret we cannot enter further upon this subject, and that I can only show you by this diagram how much the form and measurement of the burner affect the quality of the light:—

Illuminating Power of Common London Gas (13-candle), when burned from different Burners.

	Diameter of internal aperture.	Illuminating power (sperm 120).	Prcntage. difference.
Old brass burner, 15 holes .	0·70 in.	11·30	100
do. do. . .	0·57	12·12	108
Steatite do. . .	0·48	13·23	117
do. and gauze . .	,,	13·04	115
do. 15 holes . . .	0·44	13·56	120
do. and gauze . .	,,	13·35	118
do. 15 holes . . .	0·43	13·00	115
do. and gauze . .	,,	13·56	120
do. 15 holes . . .	0·42	12·50	110
do. and gauze . .	,,	13·09	116
Porcelain (Bengel), 30 holes	0·35 .	15·33	135

All the 15-hole burners had a 7-inch chimney, and the was burnt at the parliamentary rate of 5 cubic feet per per hour; but the 30 hole burner (Bengel) had an 8-inch chimney, and the gas was burnt at the rate of a little less than 4 feet per hour, and the illuminating power was then calculated to 5 feet. It is evident, therefore, that if a fixed quantity of gas—say, 5 feet per hour—is to be passed through the burner, the burner must be selected to give the maximum amount of light, and therefore no fixed measurement of burner can be specified; but if, on the other hand, the burner is a fixed instrument, then the quantity of gas passing it in a given time must be left open, and the supply must be regulated to the best effect. This, I believe, is the proper and the fairest means of estimating the illuminating power of gas. It would then be said that with a certain specified burner—as, for example, the Bengel—a certain amount of light was given with not more than a certain quantity of gas. This is the method employed in France. In Erdmann's gas-prover, however, the condition of things is reversed, as we are here estimating the quantity of air necessary to destroy the light by burning the solid carbonaceous particles, and therefore we should experiment on the gas burning at a given rate—say, 0·84 cubic foot per hour. The instrument thus gives reliable indications of the quality of the gas, as may be seen from this diagram, which is taken from the experiments of Mr. William King, of Liverpool.

Illuminating Power of Gas when burned at a given Rate in Erdmann's Gas Prover—viz., at 0·84 Rate Cubic Foot per Hour.

	Description of Gas.			
	Newcastle Coal.	Equal Parts Newcastle and Wigan.	Wigan Coal.	Boghead Coal.
Height of flame (inch)	1·87	[illegible]	2·75	5·50
No. of index of prover	4·72	23·39	32·78	61·14
Relative values of do	1·00	1·59	2·22	4·15
Coefficient of power.	0·70	0·70	0·72	0·70
Illuminating power (co-efficient = 0·7).	10·30	16·37	22·95	42·80
Do. do. by photometer	10·30	16·35	23·58	42·96
Relative values.	1·00	1·58	2·29	4·17

The general laws which have been deduced from these facts are,—1. That with all burners the maximum amount of light, in the case of common gas, is always secured by burning the gas at a pressure of from 0·8 to 0·12 of an inch of water at the orifices of ignition. 2. That with Argand burners of 15 holes the best size is the 0·06 of an inch for each hole, and with 30 holes the measurement should be the 0·024 of an inch; and with fish-tails or union burners, the holes should be the 0·06 of an inch, and the slit of the bat's-wing the 0·03 of an inch wide. 3. That the consumption of gas should be regulated in the Argand to a little below the top of the chimney, and in the fish-tail and bat's-wing it should not range beyond from 3½ to 4½ feet per hour. 4. As the measurement of the burner has much to do with the supply of air to the gas, the external diameter of an Argand burner with 15 holes and a 7-inch chimney should be 1·1 inch, and the internal diameter 0·44 inch; while in the 30-hole burner and 8-inch chimney (Bengel), the external diameter should be 0·89 of an inch, and internal diameter 0·35 of an inch; and the diameter of the nipple of the fish-tail or bat's-wing should range from 0·22 of an inch to 0·35.

These are the leading facts to be kept in view; and now, in conclusion, I have to say that there yet remain many important points for consideration, not only as regards the combustion of gas for economic purposes, but also as regards the chemistry of the waste products, as they are called in the manufacture of gas; and these I hope to have an opportunity of elucidating.

Dr. Letheby was ably assisted in his lecture by Mr. Sugg, who provided all the instruments and burners used during the lecture.

ACADEMY OF SCIENCES.

June 26—continued.

M. **Persoz** contributed another extract from his important memoir on the molecular state of bodies. The extract related to the "*Solubility of Salts*," and contained a refutation of the laws deduced by Dalton from his experiments on solubilities. These laws, which are supported by recent experiments of Playfair and Joule, are stated as follows:—

1. Anhydrous salts do not increase the volume of water in which they are dissolved.

2. Hydrated salts, in dissolving in water, increase its volume by an amount exactly equal to the water the salts contain. The above laws M. Persoz considered to be incompatible with the principle of the impenetrability of matter, and he undertook a series of experiments to elucidate the question. His method is not described in this extract, but a table of results is given, for which we have not space. We give, however, the conclusions arrived at by the experiments:—

1. When an anhydrous or a hydrated salt, which has not the power of fixing water, is dissolved, the volume of the solution is equal to the sum of the volumes of the salt and water brought together.

2. The solution of an *imperfect* salt which fixes water is always attended with condensation, but this condensation never reaches the volume of the salt.

These laws, it will be seen, are quite opposed to those of Dalton. M. Persoz remarks that a simple relation always exists between the equivalent of a salt and the water which serves to dissolve it. The volume of a saturated solution of nitre at its boiling point (131° C.) is very nearly represented by two volumes of salt and one volume of water; that of a solution of plumbic nitrate at 100° C. by one equivalent of the salt and sixteen equivalents of water.

M. Aristide Bérard sent a communication "*On a New Direct Method of Producing Cast Steel by Means of Gases.*" To get rid of the impurities of iron and produce his steel, the inventor of this process operates on the melted metal alternately with reducing and oxidising agents, in the shape of gases. Gases are also employed to generate the necessary heat. He operates in a sort of reverberatory furnace with two soles separated by a bridge. Coke is placed on this bridge to remove free oxygen. While air is sent through the metal on one side, the other is treated with a mixture of hydrogen and carbonic oxide free from sulphur. After fifteen minutes the treatment is reversed. The process is explained thus:—During the period of oxidation part of the iron is oxidised to protoxide; the earthy metals, such as silicium, aluminium, calcium, &c., are also oxidised and probably combine with the oxide of iron and form compound silicates. The sulphur, phosphorus, and arsenic also oxidise and pass away. In the period of reduction, the oxide of iron is reduced and the other metals remain in combination with the silica forming scoria, which swims on the surface. Any sulphur, phosphorus, or arsenic which escaped oxidation will now form a volatile hydrogen compound. The final process is that of decarburation, effected, we presume, by the air-blast. In this way the author states that he gets cast steel of first-rate quality. Manganese, he says, plays an indefinite part, the certain effect of which is to facilitate the conversion of the iron into steel.

M. Marignac, in a note "*On the Constitution of Hyponiobic Acid, and Tantalic and their Association in Minerals,*" states that he has experimentally demonstrated the truth of an hypothesis he published some months ago, that hyponiobic acid has the formula Nb_2O_5. He infers this formula from the constitution of the fluoride. He recommends, however, that the name should be changed to niobic acid, the name first given by Rose. The pelopic acid of the same author M. Marignac would designate niobous acid.

The author finds a large proportion of tantalic acid associated with niobic acid in columbite, and a small amount of some other metallic acid, the exact nature of which he has not yet determined.

July 3.

M. Hugo Schiff presented a note "*On the Action of Aldehydes on Rosaniline.*" The author has experimented with œnanthic and benzoic aldehydes. When the former is added to crystallised acetate of rosaniline at the ordinary temperature, and the two bodies are triturated together, a moist, crystalline, coppery-looking mass is obtained, which gives with alcohol a magnificent blue solution. Caustic alkalies precipitate red flocculi of a base which gives crystalline salts with acids. The base is the hexatomic body triœnanthylidene-dirosaniline.

$$N_6 \left\{ \begin{matrix} 2C_{20}{}^{vi}H_{16} \\ 3C_7H_{14}{}'' \end{matrix} \right. = C_{61}H_{74}N_6.$$

Benzoic aldehyde at 120° gives a crystalline product, having very similar properties to the foregoing. The author observes that the substitution products furnished by aldehydes with rosaniline support Dr. Hofmann's views of the constitution of aniline red and blue.

M. R. de Luna sent a note "*On the Deposits of Phosphate of Lime in Estremadura.*" It contained some rough analyses, from which we quote the amounts of tribasic phosphate found in several specimens. Caceres: Maximum, 72·10; minimum, 50·10. Montanchez, 85·03. The mines from which these specimens have been taken do not belong to the English Company; and the author states that he has felt it his duty to call the attention of the Spanish Government to the misfortunes that will result if these deposits are allowed to fall into the hands of Englishmen.

NOTICES OF BOOKS.

On Radiation. The "Rede" lecture delivered in the Senate-House before the University of Cambridge on Tuesday, May 16, 1865. By John Tyndall, F.R.S., &c., &c. London: Longman and Co. 1865.

A short time ago the University of Cambridge did itself an honour by conferring an honorary degree on Dr. Tyndall; and in return, if we may so say, Dr. Tyndall delivered before the University this eloquent lecture, and illustrated it in his usual brilliant and happy style. The subject is peculiarly the doctor's own, and we need hardly say that the discourse is principally occupied with those important researches the results of which have been communicated by the author to the Royal Society within the last year or two. These results have been laid before our readers as they were published, but we would, nevertheless, recommend every one to re-peruse them as brought together in these eloquent pages. On looking for an extract, we find none that will be more instructive to many of our readers than the short section on the transmutation of rays, the conversion of heat into light:—

"Eminent experimenters were long occupied in demonstrating the substantial identity of light and radiant heat, and we have now the means of offering a new and striking proof of this identity. A concave mirror produces beyond the object which it reflects an inverted and magnified image of the object; withdrawing, for example, our iodine solution, an intensely luminous inverted image of the carbon points of the electric light is formed at the focus of the mirror employed in the foregoing experiments. When the solution is interposed and the light is cut away, what becomes of the image? It disappears from sight, but an invisible thermograph remains, and it is only the peculiar constitution of our eyes that disqualifies us from seeing the picture formed by the calorific rays. Falling on white paper, the image clears itself out; falling on black paper two holes are pierced in it, corresponding to the images of the two coal points; but falling on a thin plate of carbon in vacuo, or upon a thin sheet of platinised platinum, either in vacuo or in air, radiant heat is converted into light, and the image stamps itself in vivid incandescence upon both the carbon and the metal. Results similar to those obtained with the electric light have also been obtained with the invisible rays of the lime light and of the sun.

"Before a Cambridge audience it is hardly necessary to refer to the excellent researches of Professor Stokes at the opposite end of the spectrum. The above results constitute a kind of complement to his discoveries. Professor Stokes named the phenomena which he has discovered and investigated *fluorescence;* for the new phenomena here described I have proposed the term *calorescence.* He by the interposition of a proper medium so lowered the refrangibility of the ultra-violet rays of the spectrum as to render them visible; and here by the interposition of the platinum foil the refrangibility of the ultra-red rays is so exalted as to render them visible. Looking through a prism at the incandescent image of the carbon points, the light of the image is decomposed, and a complete spectrum obtained. The invisible rays of the electric light, remoulded by the atoms of the platinum, shine thus visibly forth, ultra-red rays being converted into red, orange, yellow, green, blue, indigo, and ultra-violet ones. Could we, moreover, raise the original source of rays to a sufficiently high temperature, we might not only obtain from the dark rays of such a source a single incandescent image, but from the dark rays of this image we might obtain a second one, from the dark rays of the second a third, and so on—a series of complete images and spectra being thus extracted from the invisible emission of the primitive source."

We need only add that the lecture is published at a price that makes it accessible to every one, and, giving as it does a glowing panorama of the whole subject of radiation, is certain to be eagerly read by all who wish to be informed of the facts of these, perhaps, most important of natural phenomena.

Poggendorf's Annalen der Physik und Chemie. No. 5. 1865.

The number opens with the second part of a very valuable paper by Knoblauch, "*On the Diffusion of Heat Rays.*" This is followed by a contribution to "*The Knowledge of Nitride of Iron,*" by Dr. Stahlschmidt. The author first notices the researches of Fremy on the origin and constitution of steel, and of Berthollet, Thénard, Savart, and others on nitride of iron. He then describes the method by which he obtained the nitride. This was the process of Regnault and Fremy, who pass dry ammoniacal gas over ferrous chloride, which greedily absorbs ammonia, forming ammonio-chloride of iron. When the tube containing this is heated, the mass fuses and becomes of a dark colour, ammonia being evolved. A pale yellow, porous mass remains behind, from which, on the application of a stronger heat, nitride of iron and sal-ammoniac are formed. Simultaneously a large quantity of hydrogen escapes in consequence of an evident decomposition. The composition of the nitride of iron varies somewhat with the temperature at which it is formed, and in general the higher the temperature the smaller is the proportion of nitrogen it contains. To obtain a compound of constant composition, the ferrous chloride must be presented to the ammonia in very thin layers, and the heat applied be but just sufficient to volatilise the sal-ammoniac. The process is ended when no more vapour of sal-ammoniac is evolved; and then the passage of ammonia is continued a short time, and the tube is allowed to cool filled with the gas. In this way nitride of iron is obtained partly in thin scales, and partly as a grey powder, and then has the composition NFe_4, and is consequently an ammonium in which all the hydrogen is replaced by iron. The formation of the nitride is explained in the following way:—Ammonia is first decomposed, the hydrogen uniting with the chlorine of the ferrous chloride to form hydrochloric acid, which on its part combines with some ammonia to form sal-ammoniac. The iron at the same time combines with the nascent nitrogen and forms the nitride, while the excess of hydrogen is set free. This mode of formation is the more probable, but it may also be supposed that the nitrogen and iron combine directly at the moment they are free, according to the following equation:—

$$4FeCl + 2NH_3 = NFe_4 + 4HCl + N.$$

The author next enters upon the formation of the nitride by the action of ammonia on metallic iron, showing the influence of time and temperature on its production, and then goes on to describe the decompositions, among which we find the following:—The iron obtained by heating the nitride in hydrogen has a silver-white colour, is extraordinarily ductile, and so soft that it may be cut with ease by an ordinary knife. It dissolves in acids without leaving any residue, and is certainly the purest form of iron yet prepared. Its specific gravity is 6·03. It oxidises in the air as easily as ordinary iron, and more quickly in moist air at 100° or 120° C. It possesses also the property of condensing water on the surface when in contact with atmospheric air; nitride of iron has the same property. We may return on another occasion to the author's remarks on Fremy's theory of the formation of steel, which occupies the remainder of the paper.

The next chemical paper is by Dr. A. Steinbeck, "*On Stasfurtite,*" in which the author confirms the accuracy of the formula of Heintz and Gievert,—

$$2(3MgO + 4BoO_3) + MgCl + HO.$$

A paper "*On the Estimation of Carbonic Acid in Coal Gas,*" by Rudorff, follows. The author's method is only adapted for strict analytical purposes, and is too complicated for ordinary examinations. A drawing of the apparatus accompanies the account of the method.

The next paper is by Rudolph Weber, "*On several Compounds of Pentachloride of Antimony,*" in which he describes compounds of this body with chloride of phosphorus, oxychloride of phosphorus, chloride of selenium, chloride of sulphur, and with water.

The remaining chemical papers have no particular interest, but we may mention one by G. Tschermak, "*On the Chemical Composition of Felspar,*" which may be worth the attention of those interested in mineralogy.

Among several papers of physics of great value, we may mention one "*On a New Improvement in the Mercurial Air-pump,*" by J. C. Poggendorff, which is illustrated by a drawing.

Chemisches Central Blatt. Nos. 25 and 26.

The only novelties we find in these two numbers are a few short notices of things of practical interest, and these we transfer to our "Miscellaneous."

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

1349. H. A. Bonneville, Rue du Mont Thabor, Paris, "Improvements in hydrometers for ascertaining the strength of spirits and the specific gravity of fluids."—A communication from C. A. Valson, Rue de Pouthieu, Paris.—Petition recorded May 15, 1865.

1579. J. M. Dentith, Connah's Quay, Flintshire, North Wales, "Certain improvements in the manufacture and production of chromate and bichromate of potash employed in dyeing and printing woven fabrics."—June 10, 1865.

1662. E. Vignier, Great Tower Street, London, "Improvements in distilling and rectifying, and in the apparatus employed therein, parts of which improvements are applicable to steam generators."—June 20, 1865.

Notices to Proceed.

532. T. Routledge, Sunderland, and T. Richardson, Newcastle-upon-Tyne, "Improvements in the treatment and utilisation of certain products obtained in the manufacture of paper or of paper stock."—Feb. 25, 1865.

599. R. A. Brooman, Fleet Street, "Improvements in refining sugar, and in apparatus employed therein." A communication from A. Guillon, Nantes, France."—March 3, 1865.

788. R. A. Brooman, Fleet Street, "Improvements in the preparation of hydrated oxide of chromium." A communication from C. Kestner, Thann, France.—March 21, 1865.

1393. J. A. Coffey, Gracechurch Street, "Improvements in distilling apparatus."—May 20, 1865.

534. F. Claudet, Coleman-street, London, "Improvements in the preparation of certain iron ores or residues for use in the blast furnace."—Petition recorded February 25, 1865.

572. G. H. Barth, Highfield Villas, St. Pancras, "Improvements in condensation and refrigeration of vapours and fluids."—March 1, 1865.

590. W. E. Newton, Chancery Lane, "An improved process and apparatus for impregnating wood with chemical solutions."—A communication from E. Bazin and J. Hémery, Rue St. Sebastien, Paris.—March 2, 1865.

611. R. A. Brooman, Fleet Street, "Improvement in machinery for obtaining motive power from ammoniacal gas." A communication from J. Flandrin, Paris.—March 4, 1865.

629. T. Nicholson, Gateshead, county of Durham, "An improved process of, and apparatus for, making caustic liquor or caustic lees."—March 6, 1865.

668. G. F. Ansell, Russell Square, "An improved mode of, and apparatus for, ascertaining and indicating the presence of explosive gases."—March 9, 1865.

703. J. Webb, Lawrence Pountney Lane, London, "Improvements in the application and utilisation of certain materials suitable for the manufacture of paper." A communication from J. J. Mouteiro, Lisbon,—March 13, 1865.

727. W. E. Newton, Chancery Lane, "Improvements in apparatus for distilling oils and other liquids from coal and other substances." A communication from W. G. W. Jaeger, Baltimore, Ma., U.S.A.—March 15, 1865.

CORRESPONDENCE.

Detection of Aconite.

To the Editor of the Chemical News.

Sir,—I see by the newspaper reports of the Pritchard case that Dr. Penny has detected aconite by chemical means. Can you or any of your readers tell me of reliable tests for this poison? I have hitherto laboured under the impression that aconite could not be detected chemically, and should be glad to know the method by which it was identified. I am, &c.

Enquirer.

London, July 8.

[We believe our correspondent is mistaken. Dr. Penny relied on comparative physiological tests.—Ed. *C. N.*]

Royal Institution of Great Britain.—General Monthly Meeting, Monday, July 3, 1865.—The manager, reported, that in pursuance of the deed of endowment, they had appointed Thomas Henry Huxley, Esq., F.R.S. to be Fullerian Professor of Physiology.

MISCELLANEOUS.

Death of Dr. Daniell.—We regret to have to announce the premature decease of this gentleman, whose valuable contributions to our knowledge of the economic botany of Western and Central Africa and China are well known to many of our readers. His latest paper, on the kola nut, a new source of theine, has but recently appeared in our pages, and further communications on the same subject were promised. But incessant labour in some of the most unhealthy parts of the world had effectually broken up a strong constitution, and the Doctor died on June 26 at the comparatively early age of 47.

The Mysterious Death at Dawlish.— Dr. W. B. Herapath has forwarded to us a copy of the *Dawlish Times* containing an answer to the letter of Mr. W. Herapath, sen., which appeared in our number for June 9. We have no space for the letter, but we may say that Dr. Herapath believes it impossible that Mrs. Williams could have swallowed arsenic and strychnia at the same time. His theory is that the deceased first took the arsenic, and finding no effects in three or four hours became impatient, and then took the strychnia. But as the Doctor found no strychnia in the stomach he supposes that she spat the greater part of it out, and yet sufficient remained in the mouth to cause death in the course of half an hour or so. How it was that, under these circumstances, the twenty-thousandth part of a grain of strychnia which Dr. Herapath says he should have detected, did not find its way to the stomach we are unable to tell. We cannot say that this letter does much to clear up this "mysterious" case, which, however, does not appear to us so very mysterious.

The Search for the Philosopher's Stone in 1865.—Let those who believe that the hope of transmuting the baser metals into gold expired with the last century, shrinking from the glare of light which in this boasted age dispels all idle dreams, read the following advertisement, which appeared in the *Times* of April 4, 1865:—

"To Students in Alchymy.—Any gentleman who may require an Assistant can be recommended to an industrious foreigner, who has studied the books of the alchemists for the last fifteen years, and is a good experimentalist. He is now in Transylvania, but every information will be given by applying to Chas. F. Zimpel, M.D., 182, Marylebone-road."

Nor is the search now-a-days confined to laboratory experiments. Rumour asserts that an extraordinary rise in the price of bismuth which occurred last year was caused by the purchases of a joint stock company, established for the purpose of carrying out on a large scale the discoveries of a gentleman who, it was understood, had succeeded in perfecting the preparation of the "Stomach of Anthion," or the "Sharpness of the Eagle," or whatever may be the name of the needful alkahest. Had these modern patrons followed the examples of the shrewd Medici, who sent Augurellus of Rimini an empty purse, they had contented themselves with the purchase of an iron safe. They did more. Their "Subtle" did not profess to turn all metals into gold; their spits and pans and andirons were not available; no use to strip the churches of their coverings. They bought bismuth. Did their imagination, I wonder, like Sir Epicure's in the play, run riot among pictures such "as Tiberius took from Elephantis," among mistresses "with great smooth marbly limbs," among mists of perfume, and baths "from whence we will come forth and roll us dry in gossamer and roses;" did they surround themselves with poets and flatterers, "the pure and gravest of divines," dream of Apician dainties served "in Indian shells, and dishes of agate set in gold," and of raiment "such as might provoke the Persian?"

> "This day . . . ingots, and to-morrow
> Give lords th' affront.

To-morrow came and with it:—

> "Is all lost, Lungs? will nothing be preserved
> Of all our cost?"—"Faith, very little, Sir;
> A peck of coals or so!"

In this instance, however, the result was not quite so lachrymose. Still—even counting the "cure for the itch" off "the scraped shards"—a *fiasco*.

There is time enough yet, however, in this nineteenth century for the fulfilment of the prophecy made by the eminent Göttingen professor, Dr. Christopher Girtanner, in his memoir on Azote in the *Annales de Chimie*, No. 100, that this century will assuredly give birth to the transmutation of metals, when every chemist and every artist will make gold; when kitchen utensils will be made of silver, and even of gold, which will contribute more than anything else to prolong life, poisoned at present by the oxides of copper, lead, and iron that we daily swallow with our food. (*Pettigrew.*) This is a prosaic, but eminently practical way of looking at the rejuvenescent power of the wonderful Elixir, and one likely to prove more efficacious, I take it, in retarding the advances of old age than that method to which is attached the name of the unknown Hermippus—*puellarum anhelitu*.
A. Challsteth, Notes and Queries, June 10, 1864.

Trial of Dr. Pritchard.—The following is an abstract of Dr. Maclagan's report of the results of the chemical investigation in the case of Mrs. Pritchard:—

"I made a trial experiment, in presence of Dr. Littlejohn and my assistant, Dr. Arthur Gamgee, with three drachms of the deceased's urine, and obtained from this unmistakeable evidence of the presence of antimony. Being obliged to go to London, I requested Dr. Gamgee, in conjunction with Dr. Littlejohn, to carry on the following preliminary process in my absence. The whole contents of the intestines were evaporated to dryness on a water bath, so as to obtain a solid residue; one-half of this residue was digested with water acidulated with tartaric acid, and filtered, by which a solution measuring two ounces and five drachms was obtained, in which any antimony present in the intestines would be found. One ounce of this fluid was subjected to a stream of sulphuretted hydrogen gas, and the orange-yellow precipitate which formed was collected on a filter and washed. This precipitate, and the remainder of the tartaric acid solution, were reserved for my examination on my return to Edinburgh on the 24th of March. I then subjected these materials to the following examination. The orange-yellow precipitate was boiled in a tube with pure hydrochloric acid, and the solution thus obtained was mixed with water, when a white precipitate formed. The fluid containing this precipitate was subjected to a stream of sulphuretted hydrogen gas, and again gave a deposit of an orange-yellow colour.

"One fluid drachm of the tartaric acid solution was treated by Reinsch's method, and another fluid drachm was treated by Marsh's process. By each of these well-known methods, and thus operating upon a quantity of fluid corresponding to a forty-second part of the contents of the intestines, I obtained unequivocal evidence of the presence of antimony. By digesting a small quantity of the dried residue of the intestinal contents with distilled water, filtering and subjecting the filtrate to Reinsch's process, I readily ascertained that the antimony was here present in the form of a compound soluble in water. There are only two preparations of antimony occurring in commerce which are soluble in water; the one of these, the chloride, is a strongly acid, dark-brown, corrosive fluid, totally unsuited for internal administration; the other is what is known scientifically as tartarised antimony, and popularly as tartar emetic, a colourless substance, possessed of comparatively little taste, and in daily use as a medical agent. I have no doubt, and shall assume in the following statements, that the antimony found in Mrs. Pritchard's body was taken in this form.

"The remainder of the acid solution, amounting to one ounce and three drachms, was subjected to a process intended to determine the quantity of antimony present in the contents of the intestines; but though the presence of this metal was determined with the greatest facility, I found that the amount yielded by the materials which I used was too small to enable me to weigh it with sufficient accuracy. . . . The presence of antimony having been already ascertained in the urine, the remainder, amounting to seven ounces, was employed to determine its quantity. . . . The quantity of sulphuret was readily weighed, and found to be rather more than one-tenth of a grain (0·1078 grain). This corresponds to nearly one-fourth of a grain (·218 grain) of tartar emetic. A little more than half an ounce of bile was obtained from the gall-bladder. By Reinsch's process 50 minims readily gave an antimonial deposit. The remainder of the bile, amounting to four drachms, was used to determine the amount of antimony in it, and it yielded sulphuret of antimony corresponding to more than one-tenth of a grain (0·121 grain) of tartar emetic. The total quantity of blood was six and a-half ounces. One-half was subjected to Reinsch's process, and readily gave evidence of the presence of antimony. A portion of the liver, weighing less than four ounces (1460 grains) was subjected to Reinsch's process, and a sufficient amount of antimony was found to coat rather more than four square inches of copper foil. [Having described further experiments, the report goes on.] I obtained an amount of antimony in the state of sulphuret (0·1234 grains) corresponding to a quarter of a grain (0·25 gr.) of tartar emetic, the amount contained in the whole liver being almost exactly four grains (3·93 grs.). I next examined the remainder of the solid organs removed from the body of Mrs. Pritchard, and have to state that I have found more or less of antimony in the whole of them. . . . On the 29th of March I received from the hands of John Murray, Sheriff-officer, Glasgow, two parcels of clothes, with sealed labels attached to them, with a view to my examining some stains upon them. . . . I examined such of the stains on these articles as appeared of importance, confining my experiments to a search for antimony, and I have to state that, whilst with many of the stains the result was entirely negative, I found antimony on the following:—1st. On the chemise, from a stain obviously of discharge from the bowels, and which had been marked by me A. 2nd. On one of the sheets, distinguished by me as No. 1, in a stain marked by me B. 3rd. On the other sheet, distinguished by me as No. 2, in a stain obviously of urine, marked by me A. 4th. On a toilet cover, in a stain of a reddish colour, looking like wine stain. From the experiments, the details of which are given above, I have been led to the following conclusions:—

"1st. That Mrs. Pritchard had taken a large quantity of antimony in the form of tartar emetic.

"2nd. That having regard to the absence in her case of any morbid appearances sufficient to account for death, and to the presence in it of a large quantity of a substance known to be capable of destroying life, her death must be ascribed to the action of antimony.

"3rd. That it is most unlikely that this poison was taken in a single large dose. Had this been the case, I should have expected to have found some more decided evidence of irritant action in the mouth, throat, or alimentary canal.

"4th. That from the extent to which the whole organs and fluids of the body were impregnated with it, it must have been taken in repeated doses, the aggregate of which must have amounted to a large quantity.

"5th. That from the large amount found in the liver, from its ready detection in the blood, and from its being found passing so copiously out of the body by the bile and urine, it is probable that some of the poison had been taken at no greater interval than a period of a few days previous to death.

"6th. That I am inclined to believe that it had not been administered, at all events in any great quantity, within a few hours of her death. Had this been the case, I would have expected to have found at least some traces of it in the contents of the stomach, and more in the contents of the intestines; whereas none was found in the former, and the amount found in the latter seems to be amply accounted for by the bile impregnated with the poison discharged into them from the liver.

"7th. That the period over which the administration had extended cannot be determined by mere chemical investigation, but must be deduced from the history of the case, with which I am unacquainted.

"DOUGLAS MACLAGAN."

Composition of the Gas of some Continental Cities.—

	Heidelberg.	Breslau.	Bonn.
Hydrogen . . .	41·05	40·70	39·80
Marsh gas . . .	40·71	39·82	43·13
Carbonic oxide . .	7·64	4·01	4·66
Condensible hydrocarbons	7·28	4·96	4·75
Carbonic acid . . .	0·58	0·41	3·02
Nitrogen	2·75	10·10	4·65

The analyses were made according to Bunsen's method.—*Chem. Cent. Blatt.*, 25, 399.

To Etch in Relief on Zinc and Gild the Etching.—Boettger first makes a solution of one part of dry chloride of platinum and one part of finely powdered gum arabic in twelve parts by weight in water. With this solution he writes on clean and polished zinc with an ordinary goose quill. The writing immediately appears black from the deposition of platinum black, and now, before the writing is dry, the plate is dipped for a few moments into a solution of aurocyanide of potassium. The whole plate thus becomes covered with a very thin coating of gold; but if it be placed in dilute nitric acid (one part of acid sp. gr. 1·2 and sixteen parts of water) the layer of gold peels off the zinc, but remains fast adherent to the platinum writing. This part of the operation may be assisted by rubbing the acid on the plate with a soft camel's hair pencil. By continuing the action of the acid the writing may be obtained in tolerably strong relief.—*Journal für Prakt. Chem.*, vol. 94, p. 440.

ANSWERS TO CORRESPONDENTS.

Vol. XI. of the CHEMICAL NEWS, containing a copious Index, is now ready, price 11s. 0d., by post, 11s. 6d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. XII. commenced on July 7, 1865, and will be complete in 26 numbers.

A correspondent asks for information on the subject of albumen prepared from the roe or peas of cod-fish, and used in the print works of Alsace.

Oxamide.—We have no practical knowledge of the colour. Fine levigation might, perhaps, heighten the shade.

D. J. O.—1. In the air probably some would volatilise unchanged, and some would burn to furnish carbonic acid and hydrogen. The products formed when atmospheric air is excluded have not yet, so far as we know, been described. 2. The constituents would probably include the heavier hydrocarbons.

Lucy asks if there have been any female chemists. Miss Chenevix was, we believe, the only lady who ever exercised her abilities on the products of the test-tube and the crucible. There is no reason why ladies should not study and practise chemistry, and there are many reasons why they should choose this science to occupy their leisure moments. Surely the investigation of chemical facts would be more suitable for ladies than the study of social science, surgery, and medicine.

Received.—On Chemical Nomenclature, and Observations on some Points in the Analysis of Potable Waters, by Professor W. A. Miller, F.R.S., &c.

Books Received.—"A Course of Practical Chemistry," by Dr. Odling; "Ophthalmic Review," July.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Estimation of Uric Acid, and on the Amount contained in Human Urine, by ARTHUR H. HASSALL, *M.D. Lond., Senior Physician to the Royal Free Hospital.*[*]

THE quantity of uric acid contained in healthy human urine is estimated variously by different analytical and medical authorities, and is stated to range in the twenty-four hours from 4·32 to 14·49 grains; the mean deduced from the principal determinations hitherto made amounting, according to Parkes's table, to 8·57 grains. Between these two extremes there is a wide difference, explained in part by the imperfect observance of the precautions necessary for the estimation of this acid by precipitation with hydrochloric acid.

With a view to determine the actual amount of uric acid present in healthy urine, and guided by the various facts and particulars already detailed, I have myself instituted a great variety of experiments.

The smallest quantity of uric acid obtained in any case was 12·37 grains, and the largest 40·5 grains, the mean of the whole being 21·00 grains, equal to about $\frac{13}{100}$ of a grain to each pound of body weight. The urea was also determined, and in nearly every instance in which the uric acid was increased the urea was also augmented; and taking the mean amounts obtained of these two substances, the relation is as 1 part of uric acid to 28 of urea.

The amount of uric acid, therefore, separated by me is more than two and a half times that hitherto obtained by other observers.

It might be urged in objection that the deposits obtained did not consist in all cases entirely of uric acid, but in part of urates. No doubt in some instances they contained more or less urate and earthy phosphates; but then they were invariably incinerated and the amount of ash deducted, so that this objection would be unfounded.

Again, a further objection might be urged that, owing to the extent to which the evaporation was carried, the precipitates would contain a sensible amount of hippuric acid. This substance was therefore also sought for. Many of the larger deposits were treated with alcohol, the solution evaporated to dryness on a water-bath, and the extract weighed; this was, however, in no case so considerable as to reduce materially the high results obtained. The dried alcoholic residue, after having been weighed, was digested with strong boiling nitric acid, the liquid evaporated to dryness, and the product heated in a glass tube. Had hippuric acid been present, it would have been detected by the bitter-almond-like odour of nitro-benzine which would have been evolved, only a trace of which, however, was in any case perceptible. The alcohol, of course, abstracted the colouring matter from the precipitates, in amount not inconsiderable, as will be shown hereafter; but it must be remembered that the uric acid obtained by other experimenters was also contaminated with that substance.

So far from the amounts given by me being in excess, large as they are, I would here distinctly state my belief that they really fall short of what they ought to be, and this for several reasons. First, it is scarcely possible to be certain, whatever the precautions taken, that one obtains the whole of the urine voided in every case; second, several of the urines, and especially those first experimented upon, were not evaporated to the full extent requisite to obtain the whole of the uric acid; third, some few of the samples were evaporated at a somewhat too high a temperature; fourthly, in some instances a delay of two or three days ensued before the determination could be proceeded with. I am therefore persuaded that the real mean, instead of being 21·00 grains, is nearer 24 grains.

It is true that the mean of these results furnishes only 18 grains, but then the mean of the urea is but 488 grains. Now, taking the mean of the latter to be 512·4 grains as usually calculated, and increasing the uric acid in the same relative proportion, the mean would be raised to 18·77 grains; but the mean of the urea actually obtained by myself is 592 grains, which would furnish by calculation 21·8, or nearly 22 grains.

It is only by following out the process in all its details with the greatest care that uniform results can be obtained, and that the whole amount of uric acid contained in any urine is separated.

In the next place, numerous experiments were made with a view to determine the amount of uric acid in the urine in various cases of disease.

The smallest amount of uric acid obtained in any case was 8·74 grs., and the largest no less than 40·5 grs., the mean of the whole being 20·00 grs. In a case of Bright's disease, in which uric acid is stated to be usually very deficient, no less than 27·0 grs. were obtained.

None of the samples analysed by me contained, in any considerable amount, deposits of uric acid or urates; and I believe that urines very much richer in uric acid than any I have subjected to analysis are constantly to be met with in disease, and which would furnish on the day's excretion some 50 grs. or even 60 grs. of uric acid. In proof of the foregoing observation, I may state that I obtained, in a case of ascites, from 5000 grs. of the urine no less than 10·84 grs. of uric acid, or nearly one grain to the ounce.

Of course, during evaporation the colour of the urine becomes deeper from concentration, and the uric acid precipitated will therefore take up a larger proportion of colouring matter than it would do in a very pale and dilute urine. The uric acid obtained from concentrated urine is also amorphous, in place of crystalline, as it is when thrown down from dilute urine, and it is therefore in the condition best suited for becoming stained; it is, moreover, mixed with more or less urate. The colour of the uric acid deposits obtained from evaporated urine differs greatly, it varying from pale fawn to pink and red, according to the character of the urine from which they were obtained. The amount of acid used also affects most materially the colour; thus some of the urines, to which different quantities of the acid were added, yielded deposits differing greatly in colour. In those cases in which the largest quantity of acid was used a pink precipitate formed, as though uroërythine were present, although the experiments on the same urine with the smaller amounts of acid yielded deposits of a fawn colour. This result I have observed over and over again, and it is sufficiently curious to deserve to be recorded.

The alcoholic extracts treated with nitric acid effervesced freely, in the same manner as uric acid does under similar circumstances. This reaction may possibly be in part due to the presence of hypoxanthin.

Determination of Uric Acid by means of Hydrochloric Acid.—The variable and uncertain results hitherto obtained in the determination of uric acid

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[*] Abstract of a communication in the *Lancet*, June 17, 1865.

by means of hydrochloric acid are due not so much to any fault in the process itself, as to a want of strict attention to all the precautions necessary to ensure successful results.

I have found that the conditions under which the determination should be made are as follow :—

1st. The quantity of urine operated upon should be large; if possible, not less than 5000 grains should be taken.

2nd. The urine should be perfectly fresh, especially if it contain albumen, sugar, or other fermentable matter.

3rd. The evaporation should be slowly conducted for the two first thirds of the amount over the naked flame, but for the last third over the water-bath the rapidity of evaporation being carefully moderated towards the close of the process.

4th. In the case of concentrated urines—that is, of urines having a specific gravity of 1016 and upwards—the evaporation should be carried to the extent of about one-fourteenth the bulk operated upon; but in the case of urines below that gravity the evaporation should be carried to even one-eighteenth or one-twentieth.

5th. The acid should be added only after the urine has been evaporated, and when it has become cold, 50 grains' measure of hydrochloric acid, of specific gravity 1·11, being added to the evaporated residue of every 5000 grains of urine taken.

6th. That since the results are so materially affected by temperature, and if the determinations are made in the spring, summer, or autumn, the evaporated urine to which the requisite quantity of acid has been added should be placed in an ice-chest, furnished daily with a few fresh lumps of ice, or in a freezing mixture, and left for forty-eight hours.

7th. That the evaporated urine containing the deposit of uric acid should be filtered through pure but not too fine paper, and one yielding but an infinitesimal amount of ash. Swedish paper is usually too fine for the purpose.

8th. That the precipitate, when collected on the filter, should be washed with cold distilled water, applied by means of a small wash-bottle, the same amount of water being employed in every case—viz., 400 grains—to the precipitate obtained from 5000 grains of urine. It is desirable, of course, that as little water should be employed as possible, on account of its solvent action on the uric acid. The experiments I have detailed in this paper show that the rule laid down by Messrs. Neubauer and Vogel, of allowing ·015 grains of uric acid for every 400 grains of filtrate, is one which, applied to the urine, is practically destitute of foundation, although the amount stated represents the solubility of that acid in pure water. In every determination the filtrate and washings must be set aside for a few days in order to see if any further deposit forms, although this rarely occurs when the urine has been sufficiently evaporated.

9th. That the filters with the washed precipitate should be partially dried by placing them on thick bibulous paper, then transferred to the water-bath, and finally weighed, the latter operation being performed in a weighing tube.

10th. The filters containing the uric acid should be invariably incinerated, and the amount of ash deducted.

11th. As an additional precaution, and where extreme accuracy is desired, the precipitates prior to incineration should be digested with a mixture of three parts of absolute alcohol and one part of spirit of wine. The colouring matter thus separated, after being properly dried in a water-bath, should be weighed and the amount deducted, the ash obtained by calcination of the residue insoluble in the alcohol being likewise subtracted.

12th. In determining the uric acid in cases of disease, it is essential that the urine should be previously carefully tested for albumen, and this, even though it may be in small amount, should be completely separated; otherwise it will be weighed with the uric acid, and so increase the apparent amount. In such cases the urine should always be filtered quite hot, or some of the uric acid may become precipitated. Again, when any urine contains a deposit of either uric acid or the urates, it is necessary to well warm the urine until the deposit is completely dissolved, in order that a fair average sample may be obtained for precipitation.

It is stated in books that the occurrence of effervescence in any urine on the addition of a strong acid, as nitric acid, indicates the presence of carbonates. There never was a stronger instance of an inaccurate statement than this. When nitric acid is added to hot urine in a test tube more or less effervescence invariably ensues, and in many cases it is most copious and rapid, and causes the liquid to overflow. Now this effervescence is caused by the decomposition of the uric acid by the nitric acid, carbonic acid and nitrogen being evolved. In this fact I had hoped to have been able to found a process for the easy estimation of the uric acid, by measuring, in properly graduated tubes, the volume of the gases evolved. I made many experiments with this object, but I found that the process was not to be relied upon, and that it was subject to two fatal sources of error. Thus a portion of the colouring matter of the urine on the addition of nitric acid is also decomposed with effervescence like uric acid, the urine when heated for some time gradually losing a considerable portion of its colour; and secondly, when a mixture of urine and nitric acid is subjected to the prolonged action of heat, the urea likewise undergoes decomposition, carbonic acid being evolved. In the absence of colouring matter and urea, the uric acid may be readily determined with nitric acid, for I found that when uric acid, either free or combined, was diffused in hot water, it readily decomposed on the addition of a few drops of nitric acid.

A fact which I have also observed, and which deserves to be recorded in this place, is, that when nitric acid is added to a hot urine the mixture very quickly becomes of a dark or brown-sherry colour; this, by prolonged boiling of the mixture, gradually disappears, leaving the urine of its natural straw colour. This very striking change of colour would appear, therefore, to be due to the action of the nitric acid, not upon the true colouring matter of the urine, but upon some other substance, possibly hypoxanthine.

General Conclusions.—The two general conclusions to be deduced from the experiments detailed in this communication are—

1st. That the whole of the statistics of uric acid are destroyed by these investigations. There is not a single figure or quantity given which can be regarded as by any means accurate or precise. The statements made as to the occasional absence of uric acid from human urine I believe to be without foundation.

2nd. That many of the statements made respecting the pathology of this acid require re-examination and revision.

Wimpole-street, May, 1865.

PHARMACY, TOXICOLOGY, &c.

Preparation of Liquor Bismuthi.

MR. T. P. BLUNT communicates the following process to the *Pharmaceutical Journal* as an improvement of that of Mr. Bartlett, which appeared in our pages (vol. xi., p. 29):—

Take of subcarbonate of bismuth, 2 oz.; citric acid, 1¾ oz.; nitric acid, 3 oz.; water; solution of potash; spirit of wine,—of each what is sufficient. Dissolve the bismuth in the nitric acid, add sufficient water to take up the nitrate precipitated (from two to three ounces); carefully avoiding excess. Dissolve the citric acid in the solution thus formed (which will not be perfectly clear), and add gradually solution of potash (liquor potassæ) until the mixture is only faintly acid, and gives, after filtration, but a slight cloud on the addition of more potash. Filter, collect the precipitate, wash slightly (the presence of a trace of nitrate of ammonia in the product is of no consequence), and transfer the precipitate to a dish; add solution of ammonia gradually, until the precipitate is dissolved (a little oxide will remain); filter. Measure 4 fluid drachms of the solution, add excess of sulphide of ammonium, collect the precipitate on a counterpoised filter, wash, dry, and weigh; 261 grains of the precipitate thus obtained represent 237 of oxide of bismuth. Dilute the whole of the solution with water and spirit of wine, in such proportions that a mixture of 1 part of spirit with 7 of water shall contain the required number of grains (I generally prefer 4) to the drachm of solution. In the above process, it is especially necessary to avoid the addition of an excess of potash, which appears to decompose the citrate formed, and precipitate an oxide insoluble in ammonia, and this appears, indeed, to take place to some extent previously to saturation; a slight waste is therefore incurred, by leaving the solution faintly acid, in order to avoid the formation of this insoluble precipitate.

The chief points in which I am indebted to Mr. Bartlett, in addition to those mentioned previously, are the following:—

1. The substitution of carbonate for nitrate of bismuth. The former is far more soluble than the latter, which was used by me in consequence of its supposed greater constancy of composition.

2. The solution of the precipitate in pure ammonia. Before the appearance of Mr. Bartlett's communication, a mixture of citrate of ammonia with free ammonia was used, and heat was applied.

3. The highly important addition of a quantitative analysis. A margin was formerly left to allow for loss (which is not considerable) in the manufacture, and, as above stated, the nitrate of bismuth was used as a more uniform salt than the carbonate.

The weak points in Mr. Bartlett's process appear to be the following:—

1. The great acidity of the solution from which the citrate of bismuth is ultimately separated causes the precipitation to be extremely imperfect; there is consequently great waste of material and labour.

2. The extreme dilution of each portion of the acid bismuth solution, in the act of addition to the solution of citrate of potash, seems to determine the precipitation of basic nitrate, insoluble in ammonia, before the double decomposition necessary to the formation of the citrate can take place.

PHYSICAL SCIENCE.

*The Expansion of the Diamond and of Crystallised Protoxide of Copper under the Influence of Heat,** *by M.* H. FIZEAU.

IN pursuing my studies on the propagation of light through bodies at various temperature, I was led to make several new observations on the expansion of several bodies which have not yet been studied from this point of view.

From the nature of the results obtained, as unforeseen, as varied, and singular, it will be seen that it would be scientifically interesting to multiply as much as possible such determinations, and especially to apply them to natural groups of bodies, well defined either by their chemical composition or their crystalline form, so as to follow, under the most varied circumstances, the modifications to which this order of phenomena is susceptible, and to discover, if possible, by what law they are regulated.

The field of these researches is evidently of great extent, and but a very limited portion has as yet been explored. However, there are already a certain number of amorphous or crystallised bodies, especially those which crystallise in the regular system, whose expansions have been determined by the method employed in these researches, and in which, by means of the length of the wave of light, the most minute changes of volume in bodies only a few millimetres thick may be estimated.

I will not here enter into the details of the various important improvements suggested by experience, made in the apparatus, but will reserve them for another memoir containing the whole of the observations.

In order accurately to ascertain the temperature of the body experimented upon, the small steel tripod supporting it was placed between two concentrical stoves of thick copper, by which means the heat was uniformly distributed, and the height of the temperature very accurately taken. Further, the displacement of the fringes or rings at the surface of the body, during the changes of temperature, was watched with a small lens, and thus very precisely estimated.

Among the bodies of which I have determined the expansion, two present a remarkable phenomenon which has not hitherto been observed in any other body; this is, an expansion so slight at low temperature that great care and special observations were requisite to detect and exactly measure it. These two bodies are the diamond and protoxide of copper, both crystallising in the regular system, translucent, and with the highest indexes of refraction, but differing from each other in composition and in their chemical and physical properties. Moreover, not only is the expansion very slight in these two substances, but it very rapidly decreases as the temperature becomes lower, exactly as with water at about its maximum of density; so that it would, by analogy, appear that these two solid bodies might present the phenomenon of a maximum of density—that is to say, that their co-efficient of expansion, first positive, and decreasing, would become nothing at a certain temperature, and then negative.

The determinations hitherto made agree well with this supposition, and render probable the existence of a maximum of density for the diamond and for oxide of copper.

The following are the results of experiments:—

Diamond.—The first observations were made on a

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* *Comptes Rendus*, lx., 1161.

large plate of diamond 1·5 mm. thick, for which I am indebted to the kindness of M. Halpen; then on several stones variously cut, and among others on a beautiful brilliant procured for me by M. Mellerio. I thus observed the very slight expansion of this substance, and found that the co-efficient of expansion diminishes rapidly with the temperature; but to obtain precise measurements of these always very slight expansions it is necessary that the diamond should unite certain conditions of size, as well as of dimension and parallelism in the cut faces, conditions which are perfectly realised in one of the most valuable stones in the museum collection. This beautiful stone, which has a slightly yellow tint, weighs 1·94 gr., and is ·625 mm. thick. The administration of the Museum having entrusted it to me to determine its expansion, I took eleven series of measurements, each comprising eleven distinct observations made at different points of the stone, and at temperatures between 18° and 77°.

From these experiments it would appear very probable that the diamond has a maximum density at about 38·8°.

In the above only the linear expansion has been considered; now, the crystals of the regular system, as the diamond and oxide of copper expand equally in all directions (Mitscherlich); to ascertain the cubical expansion, the linear expansion must be multiplied by three.

Crystallised Protoxide of Copper.—The crystals of this substance are sometimes remarkably transparent to red light.

I cut a small crystal of this body into a prism, and found that it refracted the light much more than the diamond. For its refraction index with the most refrangible red ray which traversed the substance I found $n = 2{\cdot}8984$; and with the simple red ray emitted by lithia vapour in a flame $n = 2{\cdot}8489$.

Two sufficiently pure crystals from Chessy (Rhône), one octahedral the other dodecahedral, being in some parts transparent to red light, were experimented upon; their thickness was 9·844 and 10·570 mm.

Six series of measurements of twelve observations each gave concordant results, and showed decisively that the expansion of oxide of copper is, especially at low temperatures, much less than that of the diamond; and furthermore, that the value of the co-efficient also varies more rapidly, so that this co-efficient becomes rapidly smaller as the temperature decreases, and tends to become null at a higher temperature than the diamond, the increases of the co-efficient being always in proportion to the increase of heat.

Up to the present time we know only of water and some saline solutions—that is to say, of bodies in a liquid state, which present the phenomenon of the maximum of density; the existence of a phenomenon of this kind in solid bodies ought to introduce new data to the theories relative to heat, and throw a light on the molecular constitution of bodies.

Encaustic.—Bocklin gives the following process:—Moist plaster of Paris is painted with water colours as usual. When the design is perfectly dry it is painted over with a hot solution of wax and resin, and this coating is burnt in with a strong heat. The wax sinking in fixes the colour, and gives together with its compound with resin a solid transparent surface which effectually protects the painting from injury by damp or dust, the colours at the same time being greatly heightened and improved.—*Chem. Cent. Blatt.*, 26, 415.

THE
DUBLIN INTERNATIONAL EXHIBITION.

By CHAS. R. C. TICHBORNE, *F.C.S.*, *F.R.G.S.I.*, *&c.*

(*Specially Reported for the* CHEMICAL NEWS.)

(*Continued from page* 16.)

Chemical, Pharmaceutical, and Other Exhibitors in the British Department not already noticed.—J. Barrington and Sons, Dublin, soap, candles, and chemicals used in the manufacturing of the same.

Bewley and Draper, Dublin, mineral waters, perfumery, pharmaceutical preparations, and wines.

British Seaweed Company, series illustrating Stanford's patent method of making iodine, &c. The specimens in this case have become disarranged.

Bryant and May, London, patent safety matches without *phosphorus*.

Cooney and Co., Dublin, starch, dextrine, laundry blues, and samples of the raw material.

J. and C. Hare, Bristol, painters' colours.

Hirst, Brook, and Tomlinson, Leeds, acetic acid and acetates, wood naphtha, artificial fruit essences, varnishes, &c.

Johnson and Sons, Basinghall-street, London, a similar case to Johnson, Matthey, and Co., but upon a small scale. The specimens in this case are very fine; it contains refined antimony, bismuth, cadmium, and tin.

Kane, Dublin, sulphate of sodium, sulphuric acid, and bleaching powder.

Lewis, Dublin, perfumery, &c.

McMaster and Hodgson, Dublin, rape oil, linseed oil; cakes, meals(?), and seeds from which they are manufactured.

Mawson and Swan, photographic collodion and other preparations.

Piesse and Lubin, London, perfumery, odoriferous gums, fragrant woods, and plants.

Pulford and Co., London, magnetic paints.

L. Simon, Nottingham, bronze powders.

Taylor and Co., Leith, stearic acid, paraffine, candles, &c.

S. and W. Tudor, London, white and red lead, litharge, and orange lead.

J. and J. Colman, London, starch, coloured starch, mustard, and oil of mustard.

Bewley, Hamilton, and Co., Dublin, some small but extremely fine specimens of chemical and pharmaceutical products. The aloine, granulated sulphate of iron, and a few others should have been left out; they do not add to the appearance of what is otherwise a very good and evidently genuine collection.

Boileau and Boyd, a good general collection.

Patent Peat Company, Dublin, compressed peat.

Gossage, scented soaps.

British and Foreign Safety Fuse Company, patent safety fuse for blasting.

Patent Wax Soap Factory, soap made under Kottula's patent, said to be manufactured from the Japan wax.

In Section 3 we have:—

Glorney, Dublin, mustard oil, &c.

Hart, London, isinglass. One quarter of a pound of isinglass is shown cut into 50,000 shreds, which would extend over seven and a-half miles if connected. Specimens of swimming bladders, &c.

In Section 10:—

J. E. Grisdale, London, machine for washing photographic prints.

Meagher, London, photographic cameras, &c.

Noton, Salford, machine for beating up albumen, vacuum plate holder, dissolving tap for alternately admitting oxygen and hydrogen to the burners of dissolving view lanterns.

Ottewill, Collis, and Co., London, cameras.

Solomon, London, cameras.

Warner, London, camera stand.

Section 28: —

India-rubber, Gutta-percha, and Telegraph Company, Essex, St. Denis, France, and Menin, Belgium, articles in india-rubber, &c., submarine cables, &c.

Minerals and Metallurgical Operations.— Ireland is essentially a mineral country, although this fact has only received credence within the last year or so. The Irish mining operations are well represented, as all the national mining companies have their cases. Thus there is the Connorree Mining Company (limited), Avoca Company, Wicklow, native copper, copper pyrites, silver, lead ore, iron pyrites, ochre; the General Mining Company for Ireland (limited), raw and dressed calamine, arsenical pyrites, fire clay, ochre, lead and copper ores; Carysfort Mining Company, copper ores, gold, &c.

There is always a great amount of speculation attached to mining operations, and many must suffer before the resources of a country are properly opened. One of the most successful companies, and most deservedly so, is the Mining Company of Ireland. It is immaterial whether we visit their mines or their factory at Ballycorns, where the smelting operations are carried on, we find the same system carried out. No expense is spared that is likely to give a return, and perfect order is carried out in every department; whilst the wants and requirements of the employed are as much looked after as the working of the establishment. This Company has copper mines, coal mines, and lead mines in operation at the present time. The latter are situated in the valley of Glendalough, upon which Moore has written his celebrated poem,—

> "By the lake whose gloomy shore
> Skylark never warbled o'er,
> Where the cliffs hang high and steep."

This valley also contains the ruins known as the Seven Churches, described by Thackeray with such humour. These ruins are much frequented by tourists, who, however, seldom take the trouble to push up the ravine to visit these interesting mines. At the end of this ravine is a sloping amphitheatre upon a stupendous scale. If he is of a romantic turn of mind he may imagine that some Brobdignagian carter had been shooting down on every side into the said amphitheatre load after load of angular granite stones of immense proportions; not a vestige of verdure covers the rugged pile, and it would leave a gloom indeed if it were not for the busy scene which is going on in the little flat below. The mine comes out upon the surface about one-third of the way up the mountain, which mountain they have bored right through. The explorers go in at one side and come out in the other valley. In the lead mines, situated in flat countries, shafts have to be sunk; from the situation the working by shafts has but a limited application in the Wicklow mine. The mountain is penetrated in the corner of the vein by "levels." It is eighty fathoms deep (480 feet) from the apex of the mountain; the workings are carried on at a depth of more than 2000 feet. The large amount of material actually broken up in the Glendalough mine—indeed, in all mines—to get at the ore is something tremendous. There remains underground in broken stuff, which is called "deads," 22,000 tons; 10,000 rejected at the surface; treated upon the dressing floors, 14,000 tons; so that 46,000 tons of ore and rock pass through the miner's hand in the course of the year. This shows a total of 46,000 tons broken to get at 1800 tons of ore dressed for the market in this one mine, and there are many where more ore is annually turned out.

A few rare minerals are found in this mine. Thus Witherite, a very rare mineral in Ireland, has been found in very small quantities in the mines of Luganure, Another barium salt in the form of heavy spar is met with in this mine, beautifully crystallised carbonate of lead, and the black variety of carbonate of lead. But perhaps the most interesting of the collateral minerals which have been found with the lead in these mines is the native silver. Bright silver juts out of the rock in most fanciful convolutions, sometimes resembling vegetation. The native silver in this mine is generally found in direct contact with a friable and apparently disintegrated ore, which consists of sulphide of silver, also galena rich in sulphide of silver—large quantities of this ore have not been found.

Blende is found in large quantities here, but is not worked; but the finer portions of this blende get ultimately carried down from the dressing floor into the lake, and getting into the gills of the fish, literally chokes them. It is a fact that no fish will live in the lake, and this has perhaps added weight to the line—

> "By that lake whose gloomy shore."

The circumstance that we have just mentioned has given rise to the fable that the water is poisoned by the lead; but this is not the case, as the waters have been analysed and found to be free from lead. This is a practical proof of the insolubility of sulphide of lead in water.

The quantity of lead ore raised in the whole of Europe and North America is estimated at about 190,000 tons per annum. Great Britain gives 90,000, of which 2500 is raised in Ireland, or about 1·3 per cent. of the whole raised in the world.

Ireland yields about 14,000 ounces, or 2·4 per cent. of the whole of the silver raised in the world; its value may be estimated at about 3850*l.* per annum. To give an idea of the value of any mine, the tons of ore raised may be multiplied by ·7, which will give the quantity of lead.

This Company shows lead ore dressed in various stages—lead in pig, sheet, pipe, shot, and red lead. A piece of silver valued 3050*l.*, copper ore from Knockmahon, county Waterford, crystallised lead, coal and strata illustrative of the geological formation of the coal-fields of Tipperary, specimens from Ballycorns, lead slags, &c.

Other Mining and Quarrying Exhibitors.— Sir R. Griffith, Bart., geological map of Ireland, on a scale of four miles to an inch. Section from the eastern to the western coast of Ireland, showing the succession of the silurian, Devonian, and carboniferous rocks of the country. Section showing the coal series of the county of Antrim. Section showing the geological structure of the south-east of Ireland. Vertical section showing the tabular arrangement of the columnar and amorphous basalt and interlaced beds of red lithomarge of the Causeway range of the north coast of Antrim. Sectional view of M'Gillicuddy's Reeks, Killarney.

Austin, Glasgow, block coal.

Carrick-Fife, cannel coal, and oil and grease manufactured from the same coal.

J. Lisabe, Dublin, slates, ores of copper, lead, iron, baryta.

F. Danchell, Dublin, peat and condensed peat.

Kelly, Dublin, compressed peat.

Patent Peat Company, Dublin.

PROCEEDINGS OF SOCIETIES.

COLLEGE OF PHYSICIANS.

Wednesday, April 26, 1865.

"*On Animal Chemistry.*" A course of Six Lectures by WILLIAM ODLING, M.B., F.R.S., F.R.C.P.

LECTURE I.

Introductory remarks on recently-established general principles in chemistry—Plants and animals made up of distinct parts or organs—These, again, of minute parts, differing from one another in structure and arrangement—Composition of various tissue-constituents definite and independent of their structure and arrangement—Statical chemistry concerned only with the composition of parts; with the different kinds of matter of which all tissues and fluids of the body are composed—Dynamical chemistry concerned with the changes of composition undergone by various parts from time to time—Physical changes, as of a piece of iron, contrasted with its chemical changes—Special reference of chemistry to past and future changes of bodies—Every action of living body attended by changes of chemical composition—Recent advances in chemistry of tissue-products—Leucine a result of the natural metamorphosis of glandular tissue—Its artificial formation, destructively and constructively—Taurine a constituent of bile, &c.—Its artificial production from carbon, hydrogen, nitrogen, oxygen, and sulphur—Chemical types of construction and double decomposition—Compounds of hydrogen with other three gaseous elements—Establishment of molecular formulæ for hydrochloric acid HCl, *water* H_2O, *and ammonia* H_3N*—Existence in two volumes of gaseous hydrochloric acid, water, and ammonia, of one, two, and three volumes of hydrogen respectively, in addition to one volume of chlorine, or oxygen, or nitrogen—Monhydrides, dihydrides, and trihydrides in general, and their derived chlorides—Existence of analogous mono-, di-, and trichlorides of metals deduced from specific heats of respective metals, &c.—Mutual relations of chlorides, hydrates, and amides, both of elements and groupings—Interchangeability of comparable residues (*Cl *from* HCl, HO *from* $H.HO$, *and* H_2N *from* $H.H_2N$*) in great variety of compounds—Chlorinated, hydrated, and ammoniated forms of the same primitive bodies—Many complex nitrogenous tissue-products only the ammoniated forms of comparatively simple bodies—Urea, glycocine, and taurine the ammoniated forms of the carbonic, acetic or glycolic, and isethionic acids respectively.*

MR. PRESIDENT AND GENTLEMEN,—It has been, I believe, the traditional policy of this College, in its character of a learned body, to foster the cultivation of natural science for its own sake, irrespective of any immediate advantage accruing to medical practice, and regardless even of the ultimate advantage which, sooner or later, must accrue from every addition to our knowledge of the phenomena of life. I therefore make no apology, Sir, for directing your attention to topics of which the present interest, at any rate, is more scientific than practical, relying upon the favour ever extended to pure science within these walls—relying still more confidently upon the prospective ability of science to repay your favour many fold.

I feel, however, that I ought to apologise for venturing to discuss in this presence some of the more rudimentary principles of chemical philosophy; but the circumstance that these principles, despite their rudimentary character, are yet of very recent introduction must furnish my excuse. Indeed, it is only within the last fifteen years or so that chemical facts have been in any large measure subordinated to chemical principles, and only within a very few years past that these principles have been consistently developed and generally acknowledged. But the result of this development and recognition is apparent even now; for we find that notwithstanding the continuous accumulation of recorded experiment, and the continuous discovery of new and complex bodies with a rapidity at which all must be amazed, chemistry is daily becoming less and less a science of detail, more and more a science of generality, to such an extent, indeed, that in my opinion a student beginning the study of chemistry now, with a view to make himself acquainted with the knowledge of his own day, has a far less difficult task before him than had his predecessor of of twenty years ago, despite the then limited range of chemical inquiry. To some extent, therefore, I am forced, more especially in this introductory lecture, to devote a considerable proportion of my allotted time to an enunciation of certain general truths of more or less recent establishment. But, in order that we may set out from the same standpoint, I must beg still further to trespass upon your attention by reminding you briefly of the special province of chemical science, and the special character of chemical phenomena.

If we examine any ordinary plant or animal, we find in it a great number of parts or organs—root and stem, and bark and leaves, and flowers and fruit, or bones and ligaments, and muscles and viscera, and nerves and vessels. If we examine any one of these parts more minutely, we find that it also is made up of parts differing from one another, and so disposed towards one another as to present evidence of arrangement or organisation. Proceeding a little further, we find that each of these parts has a definite composition, and that the composition of the different parts is, to some extent, at any rate, independent both of their individual structure and mutual co-ordination. We find, for instance, very differently-characterised tissues composed mainly of fibrin or albumen, others of gelatine or chondrine, others of fat, and others, again, of phosphate of lime. Now, chemistry does not concern itself at all with the structure and arrangement of parts, but treats only of their composition. It distinguishes between the different kinds of matter of which all bodies whatsoever are composed, whether living or dead, structural or structureless, mineral or organic. In particular, it teaches us as physicians the composition of every tissue and fluid of the human body, and of every external agent by which that body is affected—the air we breathe, the water we drink, the food by which we are nourished, the medicines by which we are healed, and the poisons by which we are destroyed. But the knowledge of the composition of bodies is, after all, only the statical or secondary object of chemical inquiry; for, in common with physics, chemistry has primary reference to the changes which take place in the state of bodies. We consider a body not only as it now is, but as it has been, as it may hereafter be, the changes it has undergone in time past, the changes which it may undergo in time to come. Confining our attention to a single object—this piece of iron, for instance—let us consider how varied have been the states of its existence at different times. We know that it has been at rest and in motion; it has been silent and sonorous; it has been luminous and obscure, hot and cold, liquid and solid, magnetic and non-magnetic, electrical and non-electric. But throughout all these changes of rest and motion, sound and silence, heat and cold, &c., the individual piece of metal has continued one and the same; it has been composed throughout of identically the same matter. Now, so long as a body continues to be one and the same body—so long, in fact, as its composition remains unaltered, so long do all the changes which it manifests belong to the province of physics, and not to the province of chemistry. For this piece of iron to undergo a chemical change, it must cease to be a piece of iron, and become some other body—rust of iron, or vitriol of iron, or tincture of iron, or Prussian blue, or clot of blood, or some one of many hundred different combinations. Looking, then, to the chemistry of this piece of iron, we have regard to the state of ironstone in which it existed before it became metallic iron, and to the many different non-metallic states in which it may hereafter exist. The dynamical interest of a body has reference to its existence in time, to its past and future variations of state, even more than to its present condition. I venture to impress this point particularly on your attention, that while chemistry treats of the composition of bodies, it has special reference to their changes in composition. Now, when we consider that every action of the living body, every growth, every waste, every secretion, every movement, and even every thought is attended by, and consequent upon, a change of chemical composition, we perceive, in an instant, how much the future of physiology must depend upon the progress of chemical research—how only the iatro-chemist, if I may so call him, can ever hope to understand the varied series of actions, healthy and morbid, which are continually taking place in the living organism. The chemistry, then, of any animal tissue—of a piece of muscle, for instance, no less than of a piece of iron, has reference to its origin and metamorphoses. The chemist looks equally to its past and its future—to the pabulum from which it was formed, and to the products into which it is ever changing.

Of late years the chemistry of animal products has made very great advances. In the table before you are written up the names and somewhat complicated formulæ of a few of those compounds, most of which occur in the animal body, as results of the natural metamorphosis of its several tissues. Now, despite the complexity of many of these bodies, the intimate constitution of even the most complicated of them is fairly well understood, and in many cases so well understood that the bodies themselves can be actually built up by the chemist in his laboratory without having any recourse whatever to organic nature.

Animal Products.

$C H_5 N$	Methylamine.
$C H_4 N_2O$	Urea.
$C_2H_5 N O_2$	Glycocine.
$C_2H_7 N S O_3$	Taurine.
$C_3H_6 N_6$	Melamine.
$C_4H_7 N_3O$	Kreatine.
$C_6H_{13}NO_2$	Leucine.
$C_9H_{11}NO_3$	Tyrosine.

Let me direct your attention to one or two of these more particularly. Here, for instance, is leucine, a white crystalline body, consisting of 6 atoms of carbon, 13 of hydrogen, 1 of nitrogen, and 2 of oxygen. Now, leucine is a product of the use, and consequent waste or metamorphosis, of glandular tissue. It is found in decoctions of glandular tissue, more particularly of the spleen and pancreas. It also occurs occasionally as an abnormal constituent of urine. It may be made artificially in the flask or crucible by the breaking up of muscle, ligament, skin, horn, hair, feathers, and a variety of other animal substances; but so well is the constitution of this complex tissue-product understood that leucine can now be formed, not only destructively by the breaking up of more complex bodies, but constructively by a synthesis of less complex organic bodies quite independently of animal life. It may be produced, for example, by the combination with one another of water, essential oil of valerian, and prussic acid, as shown in the table, and in several other ways.

$H_2 O$	Water.
$C_5H_{10}O$	Ol. valerian.
$C H N$	Prussic acid.
$C_6H_{13}NO_2$	Leucine.

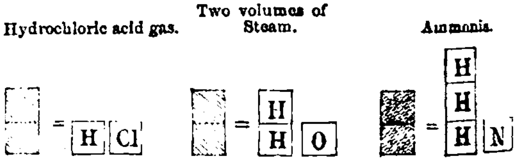
The case of taurine, $C_2H_7NSO_3$, is even more striking. Taurine, like leucine, has been found in glandular tissue, more particularly of the lung; but its chief source is the bile, where it exists conjugated with cholic acid, to form what is known as tauro-cholic acid; though whether the constituent taurine of this acid is really formed by the liver, or merely extracted by the liver from the blood of the portal vein, is not, I believe, satisfactorily established. But the constitution of this highly complex organic body, containing, as you see, carbon, hydrogen, nitrogen, sulphur, and oxygen, is so well understood that it can easily be put together in the laboratory, and from such well-known bodies as sulphuric acid, alcohol, and ammonia, each of which again is capable of being produced from its constituent elements, so that we may actually form this most interesting organic product taurine out of sulphur, charcoal, oxygen, hydrogen, and nitrogen, by processes which I hope to bring under your notice more particularly in a subsequent lecture. I might make similar remarks with regard to the greater number of these other products included in the table. Instead, however, of entering at once upon the consideration of these and similar compounds, I propose to occupy the remainder of this lecture with an account of certain bodies of a much simpler character. I mean those fundamental combinations that serve as types to which the above class of bodies and the great majority of organic as well as mineral compounds are more or less directly referrible. The recognition of these types, with the establishment of their nature and mutual relationship, constitutes the great chemical advance of the last dozen years or so; and at the present time, the proper understanding of these types enables us to give at once a more or less satisfactory interpretation of even the most recondite discoveries of modern organic chemistry.

I need scarcely remind you that among the infinite number of bodies known to chemists some of them, so far as as our present knowledge goes, appear to consist of one kind of matter only. For instance, while cinnabar may be proved to consists of two different kinds of matter, known as sulphur and mercury respectively, out of mercury we can obtain nothing but mercury, and out of sulphur nothing but sulphur. Bodies of this description, therefore, which the chemist has not succeeded in resolving into two or more different kinds of matter, are assumed to consist of one kind of matter only, and are accordingly termed simple bodies or elements. These elements amount to about sixty in number, and are possessed of very diverse properties. About four-fifths of them are metallic, as mercury, and silver, and gold, and copper, and lead, and iron. The remainder are non-metallic, as oxygen, and chlorine, and bromine, and sulphur, and phosphorus, and charcoal. The great majority of them exist naturally in the solid state. Only two are liquid, namely, bromine and mercury; while four of them are gaseous, namely, hydrogen, chlorine, oxygen, and nitrogen. Now it is the combinations of these four gaseous elements with one another, or rather, I should say, the combinations of hydrogen with the other three gaseous elements, which constitute our primary chemical types—chloride of hydrogen or hydrochloric acid, oxide of hydrogen or water, and nitride of hydrogen or ammonia—which we will now consider seriatim.

If we expose a mixture of chlorine and hydrogen gases to diffused daylight, they gradually combine with one another to produce a compound gas called hydrochloric acid—the gas which we have in this tube, and which I daresay I shall be able to render evident to you by breaking off the point of tube under water. The presence of hydrochloric acid gas in the tube is now manifested to you by its solubility in water, and by its action upon colouring matter. But, if instead of allowing the two gases to act upon one another slowly in diffused daylight, we expose them to direct sunlight, or if we bring them into contact with flame, their combination then takes place, as you see, instantaneously and with explosion. Now, it has been shown over and over again, that when chlorine and hydrogen gases unite with one another to form hydrochloric acid, it is always in the ratio of equal volumes. If we take one volume of hydrogen and one volume and a quarter of chlorine, the one volume of hydrogen unites with one volume of chlorine, and leaves the extra quarter volume of chlorine unacted upon. In the same way, if we mix together one volume of chlorine and one volume and a quarter of hydrogen, the one volume of chlorine will unite with exactly one volume of hydrogen to form hydrochloric acid, leaving the extra quarter volume of hydrogen unacted upon. Try the experiment how we please, we come to the same conclusion, that chlorine and hydrogen gases will unite only in the proportion of volume to volume. But chlorine is exactly 35·5 times heavier than hydrogen; or, taking the specific gravity of hydrogen as unity, the specific gravity of chlorine will be 35·5; or, if we call the weight of a litre of hydrogen one crith, the weight of a litre of chlorine will be 35·5 criths. Accordingly, in hydrochloric acid gas we have one volume of hydrogen united with one volume of chlorine, or 1 part by weight of hydrogen united with 35·5 parts by weight of chlorine. Moreover, when hydrogen and chlorine gases unite with one another to form hydrochloric acid gas, they undergo no alteration whatever in bulk. If we take, for instance, a litre of hydrogen and a litre of chlorine, we obtain exactly two litres of hydrochloric acid. This persistence in bulk is capable of being shown by direct experiment, but may be inferred with equal certainty by merely taking the specific gravity of hydrochloric acid gas. The weight of two litres of hydrochloric acid gas, for instance, proving to be identical with the weight of one litre of chlorine, plus that of one litre of hydrogen, it is evident that mixed hydrogen and chlorine on becoming combined hydrogen and chlorine occupy one and the same bulk before and after combination.

Turning our attention next to the combination of hydrogen with oxygen, we find that when oxygen and hydrogen gases unite with one another to form water, it is always in the proportion of one volume of oxygen to two volumes of hydrogen; and, conversely, when we decompose water electrolytically into its constituent gases, we find that for every single volume of oxygen liberated at the one pole, we have two volumes of hydrogen liberated at the other. Experiment has proved over and over again that just as chlorine and hydrogen will unite with one another only in the proportion of volume to volume, oxygen and hydrogen will unite with one another only in the proportion of one volume of the former to two volumes of the latter gas. But oxygen is found to be exactly 16 times heavier than hydrogen; or, taking the specific gravity of hydrogen as unity, the specific gravity of oxygen will be 16; or, calling the weight of a litre of hydrogen one crith, the weight of a litre of oxygen will be 16 criths. Hence, in water we have two volumes of hydrogen united with one volume of oxygen, or 2 parts by weight of hydrogen united with 16 parts by weight of oxygen. When, however, two volumes of hydrogen unite with one volume of oxygen, they do not form three volumes, but only two volumes of gaseous water or steam. That is to say, the three volumes of mixed hydrogen and oxygen form only two volumes of combined hydrogen and oxygen. This condensation is capable of being shown by direct experiment, but really we do not require any such experiment, since the result may be demonstrated with equal certainty by observing the specific gravity of steam. We find, for instance, that the weight of two litres of steam is identical with the conjoint weight of one litre of oxygen and of two litres of hydrogen; so that while from two litres of hydrochloric acid gas we can extract only one litre of hydrogen in addition to the one litre of chlorine; from the same bulk of steam or gaseous water we can extract two volumes of hydrogen in addition to the one volume of oxygen. In the experiment taking place on the table of the electrolytic decomposition of water, you see we have roughly, for the single volume of oxygen, a double volume of hydrogen; and by performing the experiment with certain precautions, we should obtain exactly twice as much hydrogen in the one tube as we obtained oxygen in the other.

Let us now direct our attention to the next typical hydride, namely, hydride of nitrogen or ammonia. The combination of hydrogen with nitrogen to form ammonia can be effected by indirect methods only, but it may be shown by a variety of processes, with which I will not trouble you, that these two gases always unite with each other in the ratio of one volume of nitrogen to three volumes of hydrogen. But nitrogen is found to be exactly 14 times heavier than hydrogen; and, accordingly, taking the specific gravity of hydrogen as unity, the specific gravity of nitrogen will be 14; or, calling the weight of a litre of hydrogen one crith, the weight of a litre of nitrogen will be 14 criths. Hence we have in ammonia three volumes of hydrogen combined with one volume of nitrogen, or 3 parts by weight of hydrogen combined with 14 parts by weight of nitrogen. Further, when one volume of nitrogen combines with three volumes of hydrogen to form ammonia, the four volumes become condensed into exactly two volumes. I cannot show you this conversion of four volumes of mixed nitrogen and hydrogen into two volumes of combined nitrogen and hydrogen, but the reverse experiment is of very easy performance. Thus, if we submit ammonia gas to the action of the electric spark, it undergoes decomposition into its elementary constituents, as you perceive. We have here two volumes of ammonia gas, which, by the continued action of the electric spark is decomposed into its constituent nitrogen and hydrogen,—and the two volumes of ammonia become gradually increased into four volumes of hydrogen and nitrogen, mixed in the proportion of three volumes of the former to one volume of the latter gas. But in this case, as in the previous two, the information afforded by a determination of the specific gravity of ammonia renders a direct experiment of any kind unnecessary. We find that the weight of two litres of ammonia gas, for instance, is identical with the conjoint weight of one litre of nitrogen and of three litres of hydrogen; so that while from two litres of hydrochloric acid gas we can extract one litre of hydrogen, and from two litres of steam we can extract two litres of hydrogen, so from two litres of ammonia we can extract three litres of hydrogen, in addition to the one litre of chlorine, oxygen, and nitrogen respectively. Or from equal volumes of chloride of hydrogen, oxide of hydrogen, and nitride of hydrogen, we may obtain one volume of hydrogen, two volumes of hydrogen, and three volumes of hydrogen respectively, in addition, in each case, to the one volume of chlorine, the one volume of oxygen, and the one volume of nitrogen, as illustrated by these models.


Hydrochloric acid gas. Two volumes of Steam. Ammonia.

(To be continued.)

ACADEMY OF SCIENCES.

July 10.

M. Gernez presented a note "*On Sources of Error in Experiments with Saturated Solutions.*" A paper by this gentleman, which we have recently published (vol. xi., pp. 250—289), states that the one cause of crystallisation in supersaturated solutions is the introduction of a solid particle of the substance in solution. The object of this note is to explain that the air is full of solid particles of salts which are deposited on every substance in a laboratory; and if iron filings seem to provoke crystallisation in a solution of sulphate of soda, or if a layer of oil on the surface of the solution does not prevent crystallisation, it is because small particles of sulphate of soda are present with both these substances. It is the same alum which the author says he has often found in dust.

M. Roux presented a memoir "*On Water Tanks for the Navy.*" This paper is of some importance, for the author discusses the question, What is the best and safest material for the construction of water tanks for ships? Galvanised iron, it seems, has been employed in the French Navy, but this is condemned by the author who finds zinc in the water kept in such tanks, and in such quantities that he considers the liquid unfit for domestic uses. M. Roux has also made experiments on the preservation of water in tanks that have been *ungalvanised* by removing the coating of zinc with hydrochloric acid, which we may suppose to represent plain iron vessels. In one of these he placed distilled water, in another water issuing from the green sand and containing some chloride of sodium, and in a third river water containing more chloride of sodium. He found the largest proportion of oxide of iron with the distilled and river water. In conclusion the author recommends for the Imperial Navy water tanks tinned inside and galvanised outside, but he does not say how such tanks are to be made.

MM. P. and E. Depouilly read a note "*On the Manufacture of Phthalic and Chloroxynaphthalic Acids.*" In a paper we published vol. xi., p. 242, the authors described the production of benzoic from phthalic acid, but they did not publish their method of producing the latter acid. We are now told that by treating naphthaline in the cold with alkaline chlorates and hydrochloric acid a large proportion of chlorine is fixed on the naphthaline in one operation, and considerable amounts of the bichlorides of naphthaline and chloro-naphthaline are obtained with but little of the protochloride. The last, an oily body, is easily got rid of by pressure. The mixture of the bichlorides is then treated with nitric acid, by which the bichloride of naphthaline is converted into phthalic acid, and the bichloride of chloro-naphthaline is transformed into chloride of chloroxynaphthyle. From such a mixture the phthalic acid is removed by boiling water, and will then serve for the process described in the previous paper. The chloride of chloroxynaphthyle, which remains undissolved, is now treated with caustic alkali in solution, and is thus converted into an alkaline chloroxynaphthalate. From the solution of this mineral acids precipitate the chloroxynaphthalic acid. This acid is purified by converting it into a soda salt from a neutral solution, of which alum will precipitate all the coloured impurities. The filtered solution now precipitated by a mineral acid deposits pure chloroxynaphtalic acid as a pale yellow crystalline powder. The salts of this acid are of considerable interest: the potash soda and ammonia salts are of a deep red colour, and give blood-red solutions. The lime salt, less soluble, is deposited from a boiling solution in silky crystals of a golden yellow colour. The baryta salt is of a beautiful orange colour; the alumina salt is madder coloured; the copper and mercury salts are bright red; zinc and cadmium give reddish brown salts; nickel and cobalt pomegranate coloured compounds; lead a nasturtium coloured salt. The aniline salt is of a beautiful red colour; the rosaniline salt is green, giving with water a solution of a beautiful cerise colour. All these salts seem applicable to industrial and artistic purposes. The acid itself dyes wood without a mordant a very deep red, and with other colours of course gives varied shades.

M. Deschamps presented a communication "*On Absinthe.*" We have several times of late years had occasion to refer to communications on this subject—a matter of very little importance to Englishmen—and we may dismiss this paper very briefly. Many French writers have ascribed the most pernicious consequences to the habit of drinking this most disagreeable of *liqueurs*, and many have supposed that wormwood is a most dangerous and insidious poison. M. Deschamps, however, believes that all the bad effects may be ascribed to the alcohol.

M. Boudin presented a note relating two instances in which the corpses of individuals killed by lightning seemed to be charged with electricity like Leyden jars, for in each instance people going to the assistance of the deceased received violent shocks.

NOTICES OF BOOKS.

Annales de Chimie et de Physique. May, 1865.

This journal opens with a long article by M. J. G. Wilm, entitled "*Researches on Thallium.*" We have much respect for M. Wilm, many of whose contributions to science have been communicated to our readers, but we believe we have a right to complain of some injustice done to us in this article. The author does occasionally refer to the Chemical News, but we must suppose that he is not a regular reader of this journal, or it is clear that his obvious bias in favour of M. Lamy's claim for priority in the discovery of the metallic nature of thallium could hardly have led him to make the misstatements here made. We refer to M. Wilm's account of the history of thallium; and as the Chemical News is much read on the Continent, we must, in justice to ourselves, but at the risk of wearying some of our English readers, refer once more, and we hope for the last time, to this dispute. After giving accurately enough the early history of the discovery, and stating that M. Lamy exhibited a small piece of the metal to the Société Impériale, &c., of Lille on May 16, 1862, M. Wilm proceeds:—"M. Lamy, however, having heard that Mr. Crookes had exhibited thallium in the International Exhibition, immediately proceeded to London; he was anxious, in fact, to compare the two products so oppositely described. On the 6th of June, 1862, he showed to several members of the Chemical Jury, more especially to MM. Hofmann, Balard, and Crookes himself, an ingot of thallium weighing twelve grammes, and communicated to them verbally the principal properties and mode of preparing the metal; *he assured himself also that the body exhibited by Mr. Crookes was not thallium, and that until then the metallic character of the element had never been recognised in England.*" In opposition to this we need only repeat what we stated in answer to M. Dumas (Chemical News, vol. vii., p. 13), that our case was deposited in the Exhibition some days before it opened on May 1, and in that case were several grains of metallic thallium; and along with it was a card on which M. Lamy, if he had known English, might have read the following:—"*Thallium, a New METALLIC Element, discovered by means of Spectrum Analysis;*" and beside this was another card on which was written:—"*Chemical Reactions of Thallium, by which it is distinguished from every other known element. It appears to have the character of A HEAVY METAL,*" &c., &c. After suspecting it for some time, we had, indeed, definitely recognised the metallic nature of the element in the previous year; but to decide our claim to priority of publication, it is only necessary to appeal to the above documentary evidence, and, to use the words of M. Wilm, "tranche le debat."

After that we need only say that the author adopts M. Dumas' classification of thallium with the alkaline metals; appropriates freely our own published researches; quotes the papers of MM. Lamy, Kuhlmann, jun., Werther, Böettger, and others; and states that his own attention has been principally directed to the chlorides, bromides, and iodides of thallium, and to the salts of the peroxide, all of which are, perhaps, the best known compounds of the metal.

The other papers in this number of the *Annales* are two memoirs by MM. H. St. Claire Deville, Caron, and Troost, re-published from the *Comptes Rendus*, "*On the Artificial*

Production of Crystalline Minerals." As the first of these was published before the Chemical News was in existence, we may quote the methods employed in the production. The authors cause pure or mixed metallic fluorides and boracic acid to react on each other at a temperature at which all these bodies meet in a state of vapour. The fluoride is always decomposed by the boracic acid, and is transformed into fluoride of boron, while the metallic fluoride is changed into an oxide, which crystallises at the moment of its production. To obtain crystalline silicates, the authors replace boracic by silicic acid. We quote the authors' method of making *Rubies.* Fluoride of aluminium, with a small quantity of fluoride of chromium, is placed in an earthen crucible, which has been carefully lined with calcined alumina, just in the same way as a crucible is lined with charcoal. In the centre of this crucible is one of platinum, containing the boracic acid, around which the fluorides are disposed. The outer crucible is well covered. When this apparatus is exposed to a temperature sufficiently high, the fluorides volatilise, and come in contact with the vapours of boracic acid from the inner crucible, above and around which the rubies are deposited. The violet red tint of these is said to be exactly like that of the most beautiful natural stones.

The remaining article is by M. P. Blaserna "*On the Compressibility of Carbonic Acid and Atmospheric Air at 100° C.*"

The Retrospect of Medicine: being a Half-Yearly Journal containing a Retrospective View of every Discovery and Practical Improvement in the Medical Sciences. Edited by W. Braithwaite, M.D., &c., &c.; and James Braithwaite, M.D. Vol. li., January to June, 1865. London: Simpkin, Marshall, and Co. 1865.

We need only notice the punctual appearance of this journal, containing, as usual, a large amount of well-selected matter, carefully condensed—matter from which we borrow a few short notices for our "Miscellanea."

The Ophthalmic Review, July, 1865.

The present number of this well-conducted journal contains the usual amount of valuable matter for ophthalmic practitioners, and one on the "*Ointment of Yellow Oxide of Mercury,*" which will be of interest to our pharmaceutical readers. This we shall extract, commending the remainder to all interested in modern Ophthalmic Surgery.

The Brewers' Journal. No. 1.

This is the first number of a periodical which will, no doubt, prove very acceptable to the brewing trade. It is intended to give all the current scientific information on the subject of brewing, together with market reports and statistics, notices of new inventions relating to the art of brewing, and odd items of general interest to the brewer. Our new contemporary has a good field to work, and we may wish the editor all success in his endeavours.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

1620. R. A. Brooman, Fleet Street, "Improvements in furnaces."—A communication from F. A. T. de Beauregard, Paris.—Petition recorded June 15, 1865.

1679. J. Gale, Devonshire Terrace, "Improvements in preparing and treating gunpowder."—June 22, 1865.

1690. M. A. Muir and J. McThoham, Glasgow, N.B., "Improved sanitary apparatus or arrangements for preventing noxious vapours, such as arise when coating or treating iron or other articles."

1695. J. Solomon, Red Lion Square, "Improvements in the preparation of magnesium for illuminating purposes."—A communication from F. P. Le Roux, Paris.

1696. C. R. Bamber, Jersey, "A new or improved apparatus for producing the magnesium light."—June 24, 1865.

1700. M. Ashby, Staines, Middlesex, "An improved brewers' and distillers' refrigerator or apparatus for cooling liquids, condensing steam, or other vapours."—June 26, 1865.

1719. W. E. Newton, Chancery Lane, "Improvements in the preparation of amalgams of quicksilver or mercury, and in the application of such amalgams to various purposes in the arts."—A communication from H. Wurtz, New York, U.S.A.—June 28, 1865.

1737. W. Schofield, Heywood, Lancashire, "Improvements in the manufacture of gas retorts and other articles made of fire-clay, and in furnaces for burning the same, and for other purposes."—June 30, 1865.

Notices to Proceed.

571. J. Young, Manchester, "Improvements in distilling bituminous substances, and in apparatus employed therein."—Petition recorded March 1, 1865.

580. T. Horton, Priors Lee Hall, Salop, and D. S. Price, Great George-street, Westminster, "Improvements in the treatment of certain products obtained in the smelting of iron."—March 2, 1865.

606. J. H. Johnson, Lincoln's Inn Fields, "Improvements in stopping bottles."—A communication from H. B. Goodyear, Hew Haven, Conn., U.S.A.—March 4, 1865.

624. F. Cruickshank, Edinburgh, N.B., "Improvements in coating for the prevention of the fouling to which iron and other ships and structures are ordinarily liable in sea-water."—March 6, 1865.

649. M. Morgans, Brendon Hills, Somersetshire, "Improvements in converting cast-iron or pig-iron into wrought iron or steel, and in machinery employed therein."—March 8, 1865.

CORRESPONDENCE.

Continental Science.

Paris, July 18.

An easy and cheap method of obtaining oxygen on a large scale is a great desideratum, and I may mention the process of M. Archereau as one that may be worth attention. This gentleman avails himself of the well-known reaction of silica upon sulphate of lime, at a high temperature, by which sulphurous acid and oxygen are evolved—

$$SiO_2 + CaOSO_3 = CaOSiO_2 + SO_2 + O.$$

The mixture of these two gases is passed into a condensing apparatus and submitted to a pressure of three atmospheres, by which the sulphurous acid is liquefied, and then the oxygen is purified by passing through milk of lime. By this process M. Archereau hopes to obtain pure oxygen at a cost of 35 centimes a cubic metre.

The use to which it is intended to apply the oxygen, as I see it stated in *Cosmos*, is certainly curious. It is proposed to compress it in cylinders, like portable gas, and employ it for increasing the illuminating power of coal gas by passing a jet of oxygen into the gas flame. The consumption of two litres of coal gas and one litre of oxygen per hour, it is said, will give a light equal to that produced by the consumption of sixteen litres of coal gas in the ordinary atmosphere; and thus, allowing for the cost of the oxygen, a saving of 45 or 50 per cent. will be effected by the consumer. Besides this saving of money, there is another advantage in the small amount of carbonic acid formed to vitiate the atmosphere of an apartment. M. Archereau, I ought to add, utilises the sulphurous acid either by converting it into sulphuric acid, or extracting the sulphur.

Your readers will have heard of the therapeutic effects of the vapours from gas purifiers in whooping-cough and other diseases of the respiratory organs. The good effects of these vapours seem to be indisputable, but the difficulty was to get at them. The gas companies might, indeed, have fitted up rooms for patients over the purifiers, as people used, and perhaps do still, in Germany have rooms for consumptive people over cow-houses; but I daresay the companies would object to have their works converted into Sanatoriums, an idea that would certainly startle the London medical officers of health who, some years ago, condemned the smell from the purifiers as an unmitigated nuisance. We live, and it is to be hoped we learn, and many a thing once esteemed a nuisance has been found to be a blessing. So it may be with the stench of the crude ammoniacal liquor from gas-works, which, diffused through a room by placing ten or twelve grammes of the liquor on a plate, will, according to MM. Burin Buisson, and De Maillard, produce all the good effects of the vapours at the works. Ammoniacal liquor is a body of complex and uncertain composition, and I must leave others to decide what are the curative agents.

Since writing the above I have found in *Les Mondes* the recipe given, by the author of the paper just mentioned, for a compound which will give off vapours exactly resembling in composition those found in the atmosphere about purifiers. It is as follows:—

Ammoniacal liquor (20° B.)	1 kilogramme.
Acetone	10 grammes.
Crude benzol . . .	10 „
„ naphthaline . .	1 „
Fresh gas tar	100 „

The naphthaline is first dissolved in the benzol, and then added with the other ingredients to the ammoniacal liquor.

I must mention also that M. Tellier has also a scheme for the manufacture and application of oxygen—of course, in reference to the production of ammonia, for which last-named gas this gentleman has so many useful applications. A not very clear account of the process is given in *Cosmos*, from which I gather that the inventor starts with hydrochloric acid, a mixture of which, with air, he passes over red-hot pumice, and so obtains chlorine mixed with nitrogen. These gases, passed with steam through a red-hot tube, give hydrochloric acid again, with a mixture of oxygen and nitrogen. So far, I dare say, all will go right; but now M. Tellier speaks of absorbing the nitrogen with an iron sponge heated to redness, and so forming nitride of iron which, reduced by hydrogen, gives ammonia! The nitrogen being absorbed, the oxygen may be collected, and with this the author proposes to accelerate the fusion of iron by burning a portion of the metal to furnish heat to melt the rest. To fuse 1000 kilos. of iron, he talks of expending 82·77 kilos. of oxygen and 217·33 kilos. of iron: the 300 kilos. of oxide he speaks of reducing cheaply, by what means is not stated.

I send this as a specimen of the style of dreaming in which some Frenchmen indulge—a style, however, not at all peculiar to Frenchmen. Patent records in all countries, I take it, include schemes no less wild.

Yet one more process for the cheap preparation of oxygen. M. Carlevaris writes to *Les Mondes*, and suggests the heating of binoxide of manganese with fine sand, in which, he says, oxygen will be evolved in consequence of the following reaction:—

$$MnO_2 + SiO_2 = MnOSiO_2 + O.$$

The theory as to the other states is quite reasonable, but the temperature required to effect the reaction will, I fancy, be rather high.

And yet one more specific for consumption. Dr. Desmartis recommends draughts of freshly drawn blood—no doubt a very nutritious, but still a very disagreeable, dose. But patients will drink it as they do more disagreeable things—if they believe that "the life of [their] flesh is in the blood."

I may mention a curious circumstance connected with death by lightning related last week by M. Boudin. Two soldiers were recently struck with lightning and killed. Some comrades who went to take up the bodies received violent shocks. The bodies appear to have become charged Leyden jars.

MISCELLANEOUS.

University College.—The prizes for Analytical Chemistry at University College, London, for the Session 1864-5 were distributed as follows:—*Gold Medal and First Certificate.*—J. J. Bourney, of London. *Certificates.*—2. Charles Graham, of Berwick-on-Tweed; 3. Manning Prentice, of Stowmarket; 4. Y. Yamaou, of Japan; 5. K. Endo, of Japan.

Exhibition of Arts and Manufactures of North Eastern London.—This exhibition will be held in the Agricultural Hall, Islington, and will open on August 16. It promises to be very superior to most of the local exhibitions recently held. We notice that the department of philosophical instruments and chemical apparatus will be very fully represented, the list of the committee containing the names of some of the principal manufacturers and members of the trade. Chemical and pharmaceutical products will also, we are told, form a considerable feature. We may mention that it is intended to devote the surplus funds of the exhibition to the establishment of a permanent museum of arts and industry somewhere in that part of the metropolis.

Theory of the Imponderables.—We have received a letter from Mr. McGauley, stating his claims to the first enunciation of the theory of imponderables laid before the Academy of Sciences by M. G. Martin, and noticed in the Chemical News, vol. xi., pp. 230-237. Mr. McGauley, it seems, sent a memoir, in which this theory was developed, to the Academy in May, 1862. It was then referred to a commission consisting of MM. Pouillet and Fizeau, who have never reported upon it. In an article in the *Scientific Review* the author states that "three years have confirmed the conviction his researches had long led him to entertain, that the imponderables are really material elements, subject, like all others, to definite laws of combination." We extract the propositions laid down by the author at the commencement of his memoir:—

"*Motion, Electricity, Heat, and Light, consist of the same Constituents, either Singly or in Combination.*

"I. The simplest form of motion (including nervous energy), electricity, heat, and light, is an element of motion in the latent state—that is, combined with matter.

"II. When an element of motion is liberated from combination with matter, by the neutralising action of a motive element of the opposite kind—that is, 'when two equal and opposite motions destroy each other,' the two electricities are set free, and when these combine, Heat is the result.

"III. When one of the calorific elements is in excess (being combined as a motive-element), the resulting heat becomes either one of the coloured rays of the solar spectrum, or an actinic ray, according to the amount of such excess, and is the more refrangible in proportion to that amount. And it is probable that the nature of the light which results depends on which calorific element (electric element) is in excess.

"IV. Both the heat elements are set free, under the form of the two electricities, during ordinary combustion, but only one of them during galvanic action.

"V. Motion is never produced, except by decomposition of heat, or by liberation of the calorific elements, during chemical action, which is true, even when the decomposition is due to electricity or electro-magnetism. And motion is never destroyed without heat being formed again, except when the calorific elements are prevented from uniting."

Transmutation of Metals.—I recollect the paragraph referred to by Mr. Irvine going the round of the papers, but I could never ascertain that there was any truth in it. It is, however, an undoubted fact that about twelve or eighteen months ago bismuth rose in price from 2s. 9d. to 24s. per pound; but I believe the company said to have been formed for transmuting it into silver to be a myth. Perhaps the following facts may clear up the mystery. The chief supply of bismuth is derived from the Royal Saxon mines at Schneeberg, which are also worked for cobalt and nickel. The lode in which these metals occur crosses in one part of its course a thin lode of silver. At the point of contact a small percentage of this metal is of course obtained; but for some time past it has been so small as not to be worth extracting, and the three metals have been sent together to this country. When the cobalt and nickel have been extracted, whatever trace of silver there may be remains in the bismuth. Possibly some one may have accidentally met with a specimen unusually rich in silver, and thence concluded that the extraction of the precious metal would turn out a profitable speculation. The Schneeberg mines are now only partially worked. A cheaper substitute for cobalt blue has been discovered, and supplies of nickel being obtained from other sources, the prices of both metals have declined. The importation of washed ore obtained from these mines used to be about 700,000 pounds per annum, but it has now fallen to about 50,000 pounds. The supply of bismuth is almost exclusively obtained from Schneeberg, and this falling off in the supply would almost of itself be sufficient to account for the rise in price of the metal. This, I think, satisfactorily disposes of the "Transmutation of Metals Company (Limited);" but I hope in a future communication to show that believers in a sort of modified alchemy are not by any means rare even in the nineteenth century.—Richard B. Prosser, 25, Southampton Buildings, W.C.—*Notes and Queries.*

[We happen to know that a professed transmutor, a German, had an office in Leadenhall-street two years ago, and for a time found dupes.—Ed. C. N.]

Arsenic Eating.—Dr. Maclagan, of Edinburgh, on a visit to Styria in the spring of this year, obtained conclusive evidence of the existence of this practice, and has published in the *Edinburgh Medical Journal* a circumstantial account of what he saw. We quote one case, in which it will be seen no jugglery could have been practised:—"Mathias Schober, a healthy-looking, fresh-complexioned, fairly muscular young man, of the age of 26 years, and about five feet nine inches in height, a native of Liegist, and employed as a house servant there, said he had taken Hüttereich for about a year and a half—not, however, white arsenic, but the yellow arsenic, or orpiment, of which he took a specimen from his pocket and showed it to me. Of this I retained a piece for chemical investigation. He informed me that he took the arsenic in order to keep strong, though he had never suffered from ill health. He said he had never experienced any bad effects, even when he first began using it; that he had at first taken rather less than a grain every fortnight; that he now took it twice a week; and that on omitting to take it for any longer period he experienced a longing for it, which was relieved by a repetition of the usual dose. His reason for taking the orpiment instead of the white arsenic was, that it was more easily procured; but having professed himself quite indifferent whether it were arsenious acid or the sulphuret, Dr. Knappe produced a paper containing the former (of which I also kept a sample), and having asked him to choose out a piece such as he was in the habit of taking, it was weighed, and found to be nearly five grains. We had no finer weight than one grain; but the piece of arsenic was much over four, though less than five. Dr. Knappe, having carefully ground this to powder on a clean piece of paper, it was transferred to a small piece of plain white bread, about as large as a man's thumb-nail, and this the doctor put into his mouth. Schober chewed it and swallowed it, and then swallowed another portion of bread the same size immediately after. This was at 9·30 a.m. He stayed with us a few minutes, but he had to return to his work, promising, however, to come back in a short while. This he did at 11·30, two hours after, and made water in my presence to the amount of what I estimated at twenty-eight ounces, into a vessel previously carefully cleaned, and the urine was put into bottles thoroughly washed by myself. Unfortunately, in the hurry of my departure, in trying to pack these bottles into my hat-box, I broke one, and thus lost part of the urine. Since my arrival in this country I subjected the contents of the two remaining bottles to chemical analysis, adopting the distillation process of Dr. Taylor as the most convenient way of separating arsenic from the organic matters of the urine. For this purpose the urine was carefully evaporated to dryness in a clean retort. The nearly dry residue was covered with strong hydrochloric acid, and distilled into a well-cooled receiver. The product, amounting to about half an ounce, was a clear, feebly pinkish fluid, thirty minims of which, when treated both by Reinsch's and Marsh's process, gave very characteristic arsenical deposits. Schoher also came the following day to see me, having taken no more arsenic since the dose which he had swallowed before me twenty-six hours previously. I again secured some urine which he passed in my presence, and this, when chemically examined as above, also yielded arsenic freely." Dr. Maclagan adds—"It is evident that the confirmation of the existence of the practice of arsenic-eating must lead us to modify some of the opinions that are entertained with regard to the influence of habit on the action of poisons. It has long been notorious that, by habit, the human body may be brought to bear with impunity doses of organic poisons, such as opium, which, to those unaccustomed to them, would certainly prove fatal; but 'it has hitherto been considered by toxicologists that, except within very narrow limits, habit appears to exercise no influence on the action of mineral poisons.' (Taylor 'On Poisons,' p. 89.) Though the experiment of M. Flandin, by which he proved that he could bring dogs to bear fifteen grains of arsenious acid in powder in twenty-four hours, without injury to their appetite or health, and the practice of administering arsenic to horses, have long been known as pointing rather in the contrary direction, this has been supposed to be due to some peculiarity in the constitution of the lower animals. The facts which have been ascertained with regard to the Styrian arsenic-eaters, and which the above observations confirm, entitle us to maintain that the modifying effect of habit is not confined to organic poisons, but extends to those of mineral nature—at all events, to arsenic."

Carbolic Acid is strongly recommended to dentists cleaning out carious teeth previous to stopping them. It is said, also, to be an effectual cure for toothache.

ANSWERS TO CORRESPONDENTS.

⁂ In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

⁂ All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. *Private* letters for the Editor must be so marked.

A correspondent asks for information on the use of cod's roes or peas in the manufacture of albumen for print works.

D. A.—The percentage on the care taken in the manufacture, and probably is never exactly the same in any two operations.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Analysis of the "Montpellier Saline Chalybeate" Water, Harrogate, by Dr. SHERIDAN MUSPRATT, *M.D. (Hon.) F.R.S. Ed., M.R.I.A., &c.*

HAVING, at the suggestion of numerous scientific men, undertaken an analysis (just completed) of the above famous spring, which is often called, in Harrogate, "Kissingen Water," although its constituents bear very little resemblance to the world-renowned Continental spa; and as Dr. Kennion, the eminent consulting physician, regards my results "most interesting as a safe guide in prescribing," I am induced to forward these few remarks, with the tabular analysis (mean of four determinations) for publication in your ably-conducted scientific journal:—

	Grains in the imperial gallon.
Carbonate of iron . . .	3·614
Carbonate of lime . . .	20·714
Carbonate of magnesia . .	1·625
Carbonate of manganese . .	trace
Chloride of calcium . . .	127·274
Chloride of magnesium . .	66·103
Chloride of potassium . .	5·400
Chloride of sodium . . .	623·419
Iodide of sodium . . .	traces
Bromide of sodium . . .	
Ammonia, &c.	
Total . .	848·149
Temperature of water . .	48°
Specific gravity . . .	1·0088
Reaction	alkaline

It contains about 24 cub. in. of carbonic acid. The Bavarian spring (Kissingen) yields more than ten times this quantity of the above gas.

The late Mr. William West, F.R.S., of Leeds, gave twenty grains of sulphate of soda in a gallon of the Montpellier saline water! It does not offer a trace of any sulphated compounds. How Mr. West found Glaubers' salt in the water must now remain a mystery.

College of Chemistry, July 25.

On the Amines of Benzoic Alcohol, by M.* CANNIZZARO.

FOR the same reason that phenols were long supposed to be analogous to alcohols, it has until lately been thought that aniline, toluidine, and their homologues were alkaloids of a constitution analogous to that of methylamine, ethylamine, etc.

The discovery of benzoic alcohol, and the comparison of its properties with those of cresylic phenol, has controverted the first of these opinions.

The facts which I have the honour of submitting to the Academy show that the alkaloid derived from benzoic alcohol, the true primary benzylamine, differs altogether from toluidine, whence it may by analogy be inferred that alkaloids derived from true aromatic alcohols differ from those which are analogous to aniline.

The following is the method for obtaining primary benzylamine:—Mix chloride of benzyl (benzhydrochloric ether) with an alcoholic solution of ammonia, and leave the whole to stand for a few days. White crystals then form in needles and flakes, which separate from the liquid.

These crystals are merely the tertiary benzylamine which I described some years ago.

Filter the liquid, distil the alcohol in a water bath, and treat the residue with hot water. There remains an insoluble matter which fuses in hot water. This is a second and slightly coloured portion of tertiary benzylamine. Evaporate the partially-cooled aqueous solution, separated by filtration from the latter substance, to dryness in a water bath. A saline residue remains, which is a mixture of a little sal-ammoniac and the hydrochlorates of primary benzylamine and of another alkaloid, probably secondary benzylamine.

Separate, by fractional crystallisation, the portion which is most soluble in water, which is nearly pure hydrochlorate of primary benzylamine.

A free alkaloid is obtained by treating a concentrated aqueous solution of this hydrochlorate by an excess of potash solution. The alkaloid then floats on the surface.

To assist the separation add ether; separate the etherial from the aqueous solution, and distil the ether in a water bath. Place the residue, slightly coloured yellow, in contact with a stick of fused potash to dry it and to preserve it from the action of the carbonic acid. After a few days separate the limpid liquid from the potash and distil, collecting what comes over at about 182°. Colourless primary benzylamine is thus obtained. This is not, however, perfectly pure; when mixed with water it gives a turbid solution, caused apparently by the presence of a little secondary alkaloid.

By repeated fractional distilllations benzylamine is at last with difficulty perfectly purified. I, however, effected this object by the following method:—I passed a current of dry carbonic acid over primary benzylamine purified as much as possible by distillations; a solid compound formed and the temperature rose. I washed this compound with perfectly dry ether, which took away the small quantity of the other alkaloid, which did not absorb carbonic acid and remained liquid. This solid carbonate, dried on blotting-paper, I dissolved in hydrochloric acid, carbonic acid was disengaged; I crystallised the hydrochlorate formed and then extracted the alkaloid by the process above described.

The alkaloid $C_7H_7H_2N$ thus separated is a colourless liquid, boiling without decomposition between 182° and 183° (uncorrected). It seems unalterable by the action of the sun; it mixes with water in all proportions; potash in excess separates it from these solutions, tinging it with yellow; it rapidly absorbs carbonic acid, giving a crystallised compound as does amylamine. It has an energetic alkaline reaction, fumes when in contact with hydrochloric acid, combines with acids with considerable disengagement of heat, and gives neutral salts. The hydrochlorate C_7H_9MHCl crystallises in striated flakes; with platinic chloride it gives a chloroplatinate crystallised in orange coloured plates.

These characteristics sufficiently show how much this alkaloid differs from toluidine. The difference consists not only in the physical characteristics and solubility in water, but also in the chemical properties. Toluidine is a very feeble alkaloid, while the basic characteristics of benzylamine are as pronounced as those of ethylamine and its homologues.

Starting upon the supposition that benzylamine is to toluidine what benzoic alcohol is to cresylic phenol, I have endeavoured to find out whether, by making the radical benzyl take the place in toluidine of the two other atoms of hydrogen which remained of the am-

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* *Comptes Rendus*, lx., 1207.

monia a body would be obtained isomeric or identical with tertiary benzylamine. The result will be communicated in a succeeding paper.

PHARMACY, TOXICOLOGY, &c.

On the Ointment of the Yellow Amorphous Oxide of Mercury, by Drs. HOFMANN *and* PAGENSTECHER.

WE borrow the following from the pages of our valuable contemporary, the *Ophthalmic Review* :—

Two forms of oxide of mercury are recognised :—

1st. The crystalline or red oxide, prepared by the dry method, and commonly known as red precipitate, constituting the very common remedy; and

2nd. The amorphous, or yellow oxide, prepared by the wet method, by precipitation; up to within a few years unknown to the Pharmacopœia, although it is indubitably preferable to the first.

The common red precipitate is rendered applicable to practice by being triturated in a porcelain mortar till no more brilliant crystalline points can be perceived; a powder is thus obtained which is quite soft, and when rubbed between the fingers no longer imparts any gritty feel. If this, after being prepared in the most careful possible way, is submitted to the microscope, it may, under a magnifying power of even 120 diameters, be recognised as a mass of broken crystals. The point up to which the trituration should be continued, which forms the measure of the fineness of the division, is in this method uncertain and inconstant. Thus this preparation occurs in different degrees of fineness in different shops; and as its efficacy is intimately connected with its fineness, the surgeon gets preparations which act with unequal strength.

For obtaining, therefore, a preparation uniform in its effects, and in the finest possible state of division, the yellow precipitate, which is thrown down, is highly to be recommended. Thinking this would also prove a far more energetic preparation, I, in 1856, for the first time prepared some, and recommended its use to Dr. Pagenstecher in his eye practice, instead of the common precipitate, and found my anticipations most gratifyingly confirmed. The mode of preparing the yellow precipitate, although well known, may be still worth mentioning. Care must be taken in the precipitation to obtain a pure oxide, and not any of its compounds, to which precipitates of mercury have a great tendency—a fact which might detract from the efficacy of the preparation. The precipitation is effected by adding a solution of the chloride of mercury to a solution of potash, in such a way that there is always an excess of the latter. After the precipitate has deposited itself, the supernatant fluid is at once poured off, the precipitate thoroughly washed with distilled water, and dried by a gentle heat, with exclusion of daylight. Thus prepared, the yellow precipitate has a light yellow (that of the yolk of an egg) colour, and is an exceedingly fine powder, which, even under the microscope, appears completely amorphous. In addition to both the above signalised properties, it differs from the ordinary precipitate in its chemical behaviour, being much more quickly acted on by reagents. A solution of oxalic acid, which acts on the red oxide only after boiling, very quickly changes the yellow oxide, even at the ordinary temperature, into the white oxalate. The preparation of hypochloric acid gas depends on the property the yellow oxide of mercury possesses of decomposing in contact with chlorine gas; the results being hypochloric acid and chloride of mercury; whereas the red oxide undergoes, with chlorine gas at the ordinary temperature, hardly any change. This difference of chemical behaviour of the two oxides constitutes a different degree of resistance to the various agents they are submitted to, and is explained by their different states of cohesion.

In respect to the use of the yellow precipitate for eye ointments, I may be allowed to say a few words on the vehicle of the ointment. The most perfect vehicle for an eye ointment must be very soft, without, however, being too fluid, lest the heavy oxide sink to the bottom; but when in contact with a moderate heat of the body, it must completely melt, so that the preparation it contains may become quickly and uniformly diffused over the eye. Besides this peculiarity of consistence, the vehicle must be as far as possible indifferent in its behaviour to the oxide, and exhibit the least possible tendency to rancidity, which might exert a deoxidising, reducing action on the oxide. Numerous experiments with hog's lard, butter, glycerine, glycerine ointment, and mixed fats, have led me to give preference to the last, and I recommend either the mixture of spermaceti, wax, almond oil, and rose-water, known as cold cream, only omitting the water, as this favours rancidity, and substituting for it quantities of almond oil, varying according to the heat of the weather; or a mixture of coca-butter and almond oil, likewise proportionate to the temperature. In both compounds the almond oil must be as fresh as possible, and had best be prepared by the apothecary himself.

As regards the strength of the ointment, I generally use one drachm of oxide to one ounce of fat. This may appear very strong to some, but experience amply shows that, applied in proper cases, it does not in any way irritate too much. Idiosyncrasies may, of course, be observed, as in every remedy; and if the ointment in a given case irritates too much, its strength may be reduced to thirty grains of oxide to the ounce. I may further remark, the two constituents of the ointment must be rubbed up to a most intimate admixture if it is to act well. The following are, then, the two formulæ :—

℞. Hydrarg. oxydat. flavi, gr. xxx.
(Via humida parati.)
Ung. cetacei, ℥ss.
Misce exactissime et fiat unguent.
℞. Hydrarg. oxydat. flavi, gr. xxx.
(Via humida parati.)
Ung. cetacei, ℥j.
Misce exactissime et fiat unguent.

THE
DUBLIN INTERNATIONAL EXHIBITION.

By CHAS. R. C. TICHBORNE, *F.C.S., F.R.G.S.I., &c.*

(Specially Reported for the CHEMICAL NEWS.*)*

(Continued from page 29.)

The Colonies.—Canada sends a magnificent collection of minerals, forwarded from the Crown lands and by the Board of Arts of Canada, Montreal. Amongst them are fine specimens of plumbago, carboniferous pyrites, nickel ores, splendid crystals of amethyst quartz, a Canadian apatite of importance, as it can be procured in large quantities, and contains 90 (80?) per cent. of phosphate of lime. This mineral is exhibited by Messrs. Rickman, of Liverpool.

The Falkland Islands send specimens of oil, crude and refined, from the king penguin. This is an oil something intermediate between cod oil and seal oil in its properties.

From the Indian museum a very interesting collection of mineral, agricultural, and manufacturing products, including materia medica, are exhibited; also a very fine collection of raw products exhibited by Mr. Baden Powell, from the Lahore Central Museum.

The Newfoundlanders are evidently trying to find applications for the fish caught in connection with the cod oil fisheries. De Grouchy and Co. show an assortment of preserved fish, and amongst others a novelty—viz., "cod tongues preserved." W. Mort, 155, Fenchurch-street, London, exhibits a stupendous block of malachite from the Peak Downs Copper Mines. Such a splendid specimen as this is really a treat to mineralogists.

Victoria has contributed largely. The Bank of Australasia sends a collection of gold selected and prepared by the bullion clerk and the bank assayer, Mr. Paterson. The total value of the gold exhibited in its different states is 3359*l.* 8s. 9d. We have also 2925*l.*'s worth from the Union Bank of Australia. This is a very interesting collection, as we have specimens of all the alluvial gold of Australia and New Zealand. It is said that the gross weight of gold which has been produced from the mines of Victoria in little more than thirteen years is over 1024 tons, the value of which is 133,861,708*l.* sterling. The mines of Victoria are now in a more prosperous condition than they have been for some years past.

In this section there are a number of essential oils new to British commerce.

The oil of peppermint has the same character as the English oil, and is distilled from English peppermint grown in the colony. It is sold at 40s. per pound. The oil of Eucalyptus Amygdaline can be produced wholesale at 3s. per pound; 1 cwt. of leaves and twigs yields 22 oz. oil. This oil is now being supplied to the London market. The gum of this tree is soluble in water, and possesses valuable tanning properties. Quantities could be shipped.

Eucalyptus Corymbosa yields an oil the wholesale price of which is 6s. per pound, as 1 cwt. of leaves and twigs will only give 9 oz. of oil. The oil of Melaleuca Ericifolia can be manufactured for 20s. per pound, 1 cwt. of leaves and branchlets yielding 4 oz. of oil. It is said that it is equal in effect to the oil from Melaleuca Leucadendron (cajeput oil). It would be interesting to see if this oil consists of the dihydrate of cajeputene of Schmidt—essential oil of Cortex Atherosperma Moschata. The physiological effects of this oil in small doses are described as diaphoretic, diuretic, and sedative, and it appears to exert a specific lowering influence upon the heart's action. "As a medicine it has been used in the Colonial Hospitals, and employed successfully in cases of heart disease. Administered in one or two drop doses at intervals." The leaves give an oil the physiological effect of which is weak in comparison.

Fine specimens of the Xanthorrœa Australis or Grass Tree Resin are shown. The solution of this gum in spirit leaves a bright red polish on wood. It contains cinnamic and benzoic acids, the action of nitric acid upon the gum gives rise to picric acid. The report also says that this gum will possibly be found useful for dyeing scarlet. Mr. Slater in this section also exhibits some damask roses, which are really fine commercial specimens, proving the desirability of further trying what the climate will do, as regards the cultivation of perfumery plants.

Other exhibitors in the Colonial Department sec 1 and 2.

Canada.—Bogart, D. Gospel, petroleum oil.

Linseed Oil Company of Toronto, linseed oil, &c.

Ceylon.—Simmonds, P. L., roccella tinctoria Nigella sativa, cassia bark, cinnamon, Juffna moss (Plocarix Candida), nutmeg fruit.

Mauritius.—Bonton, Professor A., collection of medicinal plants. These are very interesting, and are accompanied by a description.

Brousse, vanilla.

Langlos, mace and nutmegs, &c., in their natural state

Nova Scotia.—Nash, manganese.

Scott, column of coal from Albion Mines. Thirty-six feet six inches represents the thickness of the main seam.

Wamerly German Gold Mining Company, bar of gold 48 lbs., and auriferous quartz.

Queensland.—Simmonds, Dungong oil (a substitute for cod-liver oil), Australian manna.

Vancouver's Island.—Simmonds, Ostoocham oil (a fish oil recommended in place of cod-liver oil).

Victoria.—Connor, resins, &c.

Beveridge, resin of callitris verrucosa.

Hood and Co., collection of chemicals and soaps. The latter at very low prices.

Hobson's Bay Soap and Candle Company.

Müller, Dr., F.R.S., a fine collection of gums.

Foreign States—The house of Petricoli, Austria, a very ancient firm, shows in Section 2 some beautifully bleached wax, and state that it is bleached naturally, and that chemically bleached wax is always tinged, and, therefore, requires the admixture of stearine or spermaceti to make it presentable. How far this is the fact has to be proved, but the wax exhibited possesses a virgin hue which the writer has never seen equalled.

In the Belgium Department there are two exhibitors of oxide of iron, which, under the name of *minium de fer*, is extensively used as a paint for metal work. That of MM. Hoorichx and Gorrissen, Brussels, consists of burnt ochre, and is offered at a remarkably low price—about 5s. 6d. per cwt. The article exhibited by De Cartier, Brussels, costs about 16s., and is quite a different product; it is got by burning and powdering hematite, and levigating it with water. It is called *minium de fer d'Anderghem*, and is being manufactured in immense quantities. M. Cartier says that it is destined to supplant red lead and other paints for iron work; colisthar, which by its mode of production always contains some sulphuric acid, a small quantity, it is true, but enough to attack the iron and cut into it; whilst from statements made by eminent English and French chemists the use of red lead is injurious to the iron coated with it.*

PROCEEDINGS OF SOCIETIES.

COLLEGE OF PHYSICIANS.

Wednesday, April 26, 1865.

"*On Animal Chemistry.*" A course of Six Lectures by William Odling, M.B., F.R.S., F.R.C.P.

Lecture 1.

(*Continued from page 32.*)

You will observe that all I have hitherto said with regard to these three hydrides is simply a matter of experiment or observation, uncontrolled by any theory whatever. It is a matter of fact that if you take equal volumes of hydrochloric acid, steam, and ammonia gases, you can extract from the ammonia three times as much hydrogen, and from the steam twice as much hydrogen, as can be got from the hydrochloric acid; whereas the amount

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* In the British Department there are some colours exhibited under the name of "Pulford's Magnetic Paints." This can be understood as regards the brown. The blues and greens proved to be ordinary colours, containing a small quantity of magnetic oxide of iron.

of nitrogen you can extract from the ammonia is exactly equal in bulk to the amount of oxygen you can extract from the steam, and to the amount of chlorine, and, consequently, of hydrogen, you can extract from the hydrochloric acid. It is also a matter of fact that if you take equal volumes of hydrogen, chlorine, oxygen, and nitrogen, the weight of these equal volumes will be in the proportion of

$$1 : 35{\cdot}5 : 16 : 14,$$

as shown more fully in the table before you.

Gaseous Elements and Types.

Specific gravities, or weights of 1 volume.		Molecules, or weights of 2 volumes.	
H	1	H_2	2
Cl	35·5	Cl_2	71
O	16	O_2	32
H	14	N_2	28
$\frac{1}{2}$HCl	18·25	HCl	36·5
$\frac{1}{2}H_2O$	9	H_2O	18
$\frac{1}{2}H_3N$	8·5	H_3N	17
$\frac{1}{2}H_4C$	8	H_4C	16

Now we come to a matter of interpretation. From these, in addition to many other considerations, we accord to hydrogen, chlorine, oxygen, and nitrogen the atomic weights 1, 35·5, 16, and 14, and we express the comparable molecules of hydrochloric acid, water, and ammonia by the formulæ HCl, H_2O, and H_3N respectively, each of which represents the same gaseous bulk, or 2· volumes of its particular compound. This formula for water is warranted by a host of considerations. It may suffice here to remark that in composition, condensation, and properties, water H_2O, is strictly intermediate between the acid monhydride of chlorine HCl, and the alkaline trihydride of nitrogen H_3N. Now, what is true of hydrochloric acid is also true of hydrofluoric acid, hydrobromic acid, and hydriodic acid. From two volumes of each of these gases we are able to extract the same volume of hydrogen, while from equal bulks of sulphuretted, selenetted, and telluretted hydrogen, we are able to extract twice the volume of hydrogen, and from equal bulks of phosphoretted, arsenetted, and antimonetted hydrogen we are able to extract three times the volume of hydrogen that we can extract from hydrochloric acid, as indicated in the table.

Monhydrides.	Dihydrides.	Trihydrides.
HCl	H_2O	H_3N
HBr	H_2S	H_3P
HI	H_2Se	H_3As
HF	H_2T	H_3Sb

Now, we find that chlorine is not only capable of uniting with hydrogen in the proportion of volume to volume, but it is also capable of replacing hydrogen in the same ratio in a great variety of compounds. Indeed, we may consider the comparable molecules of free chlorine ClCl, and hydrochloric acid HCl, to be derived from the molecule of free hydrogen HH, by a displacement of two atoms, and of one atom, of hydrogen respectively, by equivalent quantities of chlorine. Accordingly we are acquainted with chlorides corresponding to all the preconsidered hydrides, ClCl and ClI corresponding to HCl and HI, Cl_2O and Cl_2S corresponding to H_2O and H_2S, and Cl_3N and Cl_3P corresponding to H_3N and H_3P, &c., and these chlorides when in the gaseous state are found to have exactly the same bulk as their corresponding hydrides. Thus, from two litres of oxide of chlorine Cl_2O we are able to extract two litres of chlorine and one litre of oxygen, just as from two litres of oxide of hydrogen H_2O we are able to extract two litres of hydrogen and one litre of oxygen.

Monochlorides.	Dichlorides.	Trichlorides.
ClCl	Cl_2O	Cl_3N
ClI	Cl_2S	Cl_3P
ClNa	Cl_2Zn	Cl_3Al
ClK	Cl_2Ca	Cl_3Au
ClAg	Cl_2Hg	Cl_3Bi

The metals do not, as a rule, combine with hydrogen, but their chlorides may be divided into three classes, corresponding to the chlorides of the non-metals, by having regard to such considerations as the following:—We find that the proportions of the solid non-metals, iodine, sulphur, and phosphorus, which unite with one, two, and three volumes of hydrogen respectively, and with one, two, or three volumes of chlorine, as shown on the above table, and which we have agreed to regard as their atomic proportions, have the same specific heat as one another. Now, if we take for the atomic proportions of the different metals those quantities of the several metals which have the same specific heat as one another and as the atomic proportions of the solid non-metals, then we find that the chlorides of the metals, like those of the non-metals, may be divided into monochlorides, dichlorides, and trichlorides respectively, as shown in this next table. For instance, we have in this table a list of chlorides of metallic and hydrides of non-metallic compounds corresponding with one another.

Elements.	Atomic weights.	Specific heats of at. weights.	Formulæ.
Monads—			
Bromine . .	80	6·74	BrH
Iodine . .	127	6·87	IH
Lithium . .	7	6·58	LCl
Sodium . .	23	6·75	NaCl
Potassium .	39	6·61	KCl
Silver . .	108	6·15	AgCl
Dyads—			
Sulphur . .	32	5·68	SH_2
Selenium. .	79·5	6·65	SeH_2
Tellurium .	129	6·11	TeH_2
Manganese .	55	6·69	$MnCl_2$
Iron . .	56	6·37	$FeCl_2$
Cobalt . .	59	6·31	$CoCl_2$
Nickel . .	59	6·41	$NiCl_2$
Copper . .	63·5	6·04	$CuCl_2$
Magnesium .	24	5·99	$MgCl_2$
Zinc . .	65	6·26	$ZnCl_2$
Cadmium .	112	6·35	$CdCl_2$
Mercury . .	200	6·38	$HgCl_2$
Triads—			
Phosphorus .	31	5·85	PH_3
Arsenic . .	75	6·10	AsH_3
Antimony .	122	6·19	SlH_3
Bismuth . .	210	6·47	$BiCl_3$
Aluminum .	27·5	5·87	$AlCl_3$
Thallium. .	203	6·81	$TlCl_3$
Gold . .	196·5	6·37	$AuCl_3$
Tetrads—			
Tin. . .	118	6·63	$SnCl_4$
Lead . .	207	6·50	$PbEt_4$
Palladium .	106·5	6·31	$PdCl_4$
Platinum .	197	6·39	$PtCl_4$

Only a few of these metallic chlorides can be vapourised at manageable temperatures ;, but with regard to such of them as are moderately volatile, it is found that two litres of their respective vapours contain as many litres of chlorine as are indicated by their respective formulæ deduced from the specific heats of their constituent metals. With regard to corrosive sublimate vapour, for instance, we find that from two litres of chloride of mercury Cl_2Hg, we can extract two litres of chlorine, just as we can from the same bulk of chloride of oxygen Cl_2O ; whereas, if we take two litres of chloride of bismuth Cl_3Bi, we can extract therefrom three litres of chlorine, just as from two litres of chloride of phosphorus Cl_3P we can extract three litres of chlorine. We find, then, that in the case of those metallic chlorides which are volatisable we can get from 2 volumes of their respective vapours quantities of chlorine corresponding to the quantities obtainable from similarly formulated non-metallic chlorides. I may take the opportunity of saying that from considerations of this sort, together with others of almost equal cogency, it is demonstrable that the formula for corrosive sublimate, Cl_2Hg, in the old London Pharmacopœia is right, while that in the British Pharmacopœia, HgCl, is indisputably wrong. In the present state of knowledge, the matter no longer admits of any question whatever.

Having thus considered our primary hydrides of chlorine, oxygen, and nitrogen, as typical of monad, dyad, and triad combinations in general, I now wish to direct your attention, lastly, to their mutual relationship. Here we have them written up in an easy form :—

Chlorides.	Hydrates.	Amides.
HCl	H(HO)	$H(H_2N)$.
KCl	K(HO)	$K(H_2N)$.
$ZnCl_2$	$Zn(HO)_2$	$Zn(H_2N)_2$.
PCl_3	$P(HO)_3$	$P(H_2N)_3$.

If under suitable conditions we act upon hydrochloric acid HCl, water H.HO, and ammonia $H.H_2N$ by a metal—say by potassium—we obtain in each instance the same reaction. The one atom of potassium turns out one atom of hydrogen; and from each of the three molecules, instead of chloride, oxide, and nitride of hydrogen, we get the chloride, hydrate, and amide of potassium, which may be regarded as compounds of potassium K, with the residues or radicles chlorine Cl, euryzen HO, and amidogen H_2N. Hence, caustic potash and potassamide may be regarded as the hydrated and ammoniated forms of chloride of potassium. In a similar manner to nearly every chloride, mineral or organic, simple or compound, there exists a corresponding hydrate and amide bearing to it the same relation that caustic potash and potassamide bear to chloride of potassium. We may consider chloride of potassium, for instance, as a compound of the metal potassium, with the residue from hydrochloric acid. And in the same way we may consider caustic potash as a compound of the metal with the residue from water, and potassamide as a compound of the metal with the residue from ammonia; and hereafter it will appear that some of the most complicated products of tissue metamorphosis are merely the ammoniated forms of very simple bodies, just as potassamide is the ammoniated form, and caustic potash the hydrated form of chloride of potassium.

If in chloride of zinc $ZnCl_2$, we replace the two atoms of chlorine by euryzen or peroxide of hydrogen, we obtain hydrate of zinc ; whereas if we replace them by amidogen we obtain zincamide. Similarly if in chloride of phosphorus PCl_3, we replace the three atoms of chlorine by peroxide of hydrogen, we obtain phosphorous acid; whereas if we replace them by amidogen we obtain phosphoramide; these three bodies being, so to speak, the phosphorus representatives of hydrochloric acid, water, and ammonia, or of chloride of potassium, caustic potash, and potassamide.

Passing on to organic compounds, marsh gas is found to consist of one atom of carbon united with four atoms of hydrogen. Now, if we take the chlorine derivative of this marsh gas—that is, if instead of CH_4 we take CH_3Cl,—and replace the atom of chlorine by an atom of peroxide of hydrogen, we obtain ordinary wood spirit; whereas if we replace it by amidogen we obtain methylamine, a very common product of the putrefactive decomposition of animal matter, as shown in the first line of the next table :

Chlorides.	Hydrates.	Amides.
CH_3Cl	$CH_3(HO)$	$CH_3(H_2N)$
$COCl_2$	$CO(HO)_2$	$CO(H_2N)_2$
$C_3N_3Cl_3$	$C_3N_3(HO)_3$	$C_3N_3(H_2N)_3$
$C_2H_3ClO_2$	$C_2H_3(HO)O_2$	$C_2H_3(H_2N)O_2$
$C_2H_5ClSO_3$	$C_2H_5(HO)SO_3$	$C_2H_5(H_2N)SO_3$.

Again, if in phosgene gas $COCl_2$ we replace the two atoms of chlorine by peroxide of hydrogen, we obtain carbonic acid ; whereas if we replace them by two atoms of amidogen we get urea, as shown in the second line of the table. Physiologists regard urea as a complex organic body altogether *sui generis*. The chemist regards it merely as the ammoniated form of one of the simplest mineral acids. The relation of phosgene and carbonic acid to urea is identical with that of hydrochloric acid and water to ammonia, and with that of caustic potash, and chloride of potassium, to potassamide. Proceeding a little further, if in cyanuric chloride $C_3N_3Cl_3$ we replace the three atoms of chlorine by three atoms of peroxide of hydrogen, we get cyanuric or pyro-uric acid ; whereas if we replace them by amidogen, we get melamine, a product of the action of heat upon urea. Passing on to chloracetic acid $C_2H_3ClO_2$—a derivative of common acetic acid $C_2H_4O_2$, by the substitution of an atom of chlorine for hydrogen—if in this body we replace the chlorine by peroxide of hydrogen, we obtain glycolic acid ; whereas if we replace it by ammonia, we obtain glycocine or sugar of gelatine, glycocine being only an ammoniated form of the glycolic and chloracetic acids.

The next formula, $C_2H_5ClSO_3$, represents chlor-ethyl sulphurous acid, and if in this body we replace the atom of chlorine by an atom of peroxide of hydrogen, we obtain isethionic acid; whilst if we replace it by amidogen, we obtain a compound of which we have already spoken, namely, taurine—taurine, isethionic acid, and chlor-ethyl-sulphurous acid being respectively the amidated, hydrated, and chlorinated forms of one and the same body, being, in fact, ethyl-sulphurous varieties of hydrochloric acid, water, and ammonia.

You perceive that this establishment between most complicated and diverse bodies of relations similar to those subsisting between hydrochloric acid, water, and ammonia—between chloride of potassium, caustic potash, and potassamide—furnishes us with a key to the composition and metamorphoses of a whole host of organic compounds ; but the generalisation is capable of being pushed much farther. In bodies with two atoms of chlorine, we may replace either one or both of them by euryzen or by amidogen ; or we may replace one of them by amidogen and the other by euryzen ; whilst in bodies containing three or four atoms of chlorine, the possible number of derived bodies increases in a very rapid manner, according to the well known algebraic rule of combinations. I have here written down the names of a few well-known double chloro-hydrates, chloro-amides, and amid-hydrates, by way of illustration.

CuF_2	Cupric difluoride.
CuF.HO	Cupric fluorhydrate.
$HgCl_2$	Mercuric dichloride.
$HgCl.H_2N$	Mercuric chloramide.
$C_3N_3.Cl_3$	Cyanuric trichloride.
$C_3N_3.Cl(H_2N)_2$	Cyanuric chloro-diamide.
$C_3N_3(HO)_3$	Cyanuric trihydrate.
$C_3N_3(HO)_2(H_2N)$	Cyanuric dihydrate-amide.
$C_3H_3(HO)(H_2N)_2$	Cyanuric hydrate-diamide.
$C_3N_3(H_2N)_3$	Cyanuric triamide.

First of all we have difluoride of copper, or cupric difluoride, followed by cupric fluorhydrate ; next we come to mercuric dichloride or corrosive sublimate, and then to mercuric chloramide, or white precipitate, a body in which one of the original chlorine atoms is replaced by amidogen. Next we come to cyanuric trichloride and its numerous derivatives, in the first of which, namely, cyanuric chloro-diamide, two of the original chlorine atoms are replaced by amidogen. Then we have in succession cyanuric trihydrate or ordinary pyro-uric acid, cyanuric dihydrate-amide or melanuric acid, cyanuric hydrate-diamide or ammeline, and lastly cyanuric triamide or melamine, a body produced, as I have already said, by the action of heat upon urea.

I refrain from entering into further details upon this subject. I have shown you the wide applicability of the generalisation, and that by its means we are capable of associating with one another the most diverse bodies, and establishing between them the same simple relations which subsist between hydrochloric acid, water, and ammonia; and in particular I have shown you that some of the best known products of tissue metamorphosis are in reality only the ammoniated forms of comparatively well known bodies. In my next lecture I shall endeavour to satisfy you that the complex character of many organic bodies is more apparent than real, and that most of them may be resolved into comparatively simple molecules, which are capable of being distributed into certain well defined groups and series; and I shall take, as a concrete illustration of the point I wish to establish, the composition of salicine among vegetable, and of hippuric acid among animal products.

ON LECTURE ILLUSTRATIONS.

By A. W. Hofmann.

A Discourse Delivered to the Members of the Chemical Society, Thursday, February 2.

(Reprinted by permission of the author from the Journal of the Chemical Society, Ser. 2, vol. iii., p. 156.)

The introduction into modern chemistry of the idea of structural types, and the prominence given thereby to volumetric considerations, involve the necessity of modifying, to a certain extent, our present style of experimental illustrations. This necessity, I believe, has been felt by many teachers who have endeavoured to reflect the present aspect of chemistry in their lectures. In these endeavours many new and interesting experiments must have been devised already; and if an interchange of the valuable information thus acquired could be effected, a large expenditure of time and labour would be saved to those engaged in teaching chemistry. The Chemical Society, comprising as it does a great many professors of our science, appears to be an appropriate centre to attract this floating knowledge for condensation and distribution. It is in the conception of this mutual benefit which we might derive from communications of this kind, that I venture to submit to the Society an account of some of the volumetrical experiments on the composition of the typical hydrogen compounds, with the study of which, during the last few years, I have been in the habit of opening my course of lectures on experimental chemistry.

Hydrochloric Acid.

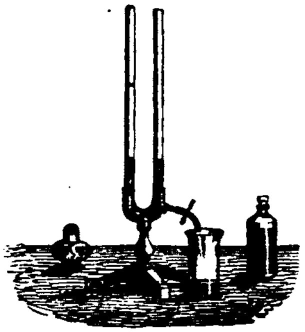
The usual method of illustrating the composition of hydrochloric acid, recommended in Manuals on Experimental Chemistry, consists in introducing a small ball of sodium into a volume of the gas, confined over mercury. Since the metal has to be heated, the upper part of the tube is bent (*cloche courbe*). It need scarcely be mentioned that a vessel of this form is very little appropriate for comparing the volume of the hydrochloric gas with the volume of the hydrogen gas evolved by the action of sodium; hence the necessity of measuring the gas in a graduated tube, of transferring it to the *cloche courbe*, and of re-transferring it to the graduated vessel, after the action has taken place. The experiment thus becomes tedious, difficult, and inaccurate. Again, how is it possible to introduce the metallic sodium into the gas without its surface having become oxidised? Not to speak of the rapidity with which the metal is amalgamated during its passage through the mercury.

By adopting the following mode of proceeding these difficulties are in a great measure obviated.

A U-shaped glass tube, about 50 centimetres long by 1·5 in diameter, having one sealed and one open limb, is fixed upon a convenient stand. Just above the bend of the tube, the open limb has a small outlet tube (blown on at the lamp), and to this is affixed a piece of caoutchouc tubing, with an elastic wire nipper (nipper-tap) attached, or provided with a screw (screw-tap), by the action of which the caoutchouc tube is pinched close, but can be readily opened at pleasure.

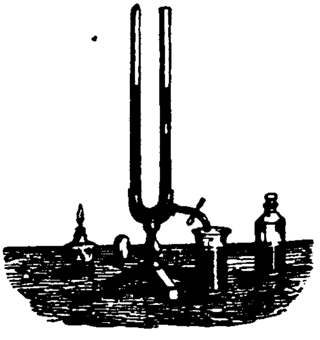
This apparatus has to be filled with an appropriate volume of the gas to be examined. For this purpose the U-tube is first filled with mercury, and then the nipper-tap is set open, so as to afford a gradual exit to the metal in the open limb. The delivery-tube of a gas-generating apparatus is then passed down the open limb to the bend of the tube, in such a manner that the gas bubbles up through the mercury into the sealed limb, from which, of course, the metal escapes as the gas enters volume for volume. An appropriate quantity of dry hydrochloric acid gas having been thus introduced, the nipper-tap is closed, and mercury is poured into the apparatus, until it stands at the same level in both limbs. The space occupied in the tube by the gas is then marked in any convenient way; preferably by a caoutchouc ring slipped over the tube (Fig. 1).[*]

Fig. 1.



That portion of the open limb which is unoccupied by mercury is then filled with sodium-amalgam, and the orifice of the tube is closed, either by the thumb, or more conveniently, by a glass stopper. The gas may now, by inclining the tube adroitly, be easily transferred from the sealed to the stoppered limb; traversing of course, in its passage, the column of sodium amalgam, and being thereby decomposed. To insure complete decomposition, the apparatus should be once or twice shaken, so as to bring every portion of the gas into thorough contact with the amalgam; after which, by reversing the previous inclination of the tube, the gas may be re-transferred to the sealed limb of the apparatus. On removing the stopper or thumb from the mouth of the open limb, the mercury falls a little therein, and may be further lowered by opening the nipper-tap. As soon as the mercury stands at a uniform level in the two limbs the gas is found reduced to exactly half its original volume (Fig. 2). The residuary gas is readily recognised as hydrogen, by transferring it to the open limb; or, the closed limb may be provided with a glass stopcock (see Fig. 11), and the hydrogen expelled by pouring mercury into the open limb. In either way the gas is found to be inflammable, and to burn with the pale flame of hydrogen gas.

Fig. 2.



This experiment shows us that a given bulk of hydrochloric acid contains half that bulk of hydrogen. It only remains, therefore, to determine with what proportion, by volume, of chlorine, this bulk of hydrogen is combined in hydrochloric acid.

This we learn from a second experiment. We submit hydrochloric acid to electrolysis in any convenient appa-

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[*] The illustrations given in this lecture are taken from a little work shortly to be published, entitled, "Introduction to Modern Chemistry, Experimental and Theoretic: Lectures delivered in the Royal College of Chemistry, London."

ratus which permits collecting the gases evolved during the process. At starting, the chlorine is almost entirely absorbed by solution in the surrounding liquid; nor is it till this is saturated that the chlorine begins to be manifested in a stream of bubbles, like those which, from the first, mark the escape of hydrogen at the opposite pole. At this stage of the process the delivery-tube of the apparatus is attached, by means of a caoutchouc connector, to a glass tube, about 40 or 50 centimetres long by 1·5 centimetre in diameter, drawn out, before the lamp, to a fine point at each end. This tube is thus filled with the mixture of hydrogen and chlorine evolved by the electrolysis of hydrochloric acid. In order to expel every trace of air, it is necessary that the mixed gases should be suffered to traverse the tube for a considerable time. To prevent the chlorine escaping into the air, the free end of the tube is connected with the lower part of an upright cylinder containing coke, moistened with an alkaline liquid capable of absorbing the chlorine. After the lapse of one or two hours the operation may be considered complete. The tube being now detached, its fine-drawn ends are immediately sealed.

The tube having been sealed at each end, its gaseous contents have next to be examined. For this purpose it is requisite to bring the mixed gases into contact with a liquid capable of absorbing the chlorine, but not the hydrogen. Water, of course, answers this purpose, but a little soda may be conveniently mixed with it to increase its absorptive power. Again, the addition of a vegetable colour—of an infusion of logwood, for instance—to tint the soda solution employed, is useful as a means of evincing the presence of chlorine by exhibiting its bleaching action on the colour, so soon as it comes into contact therewith. By plunging the sealed finely-drawn extremity of the tube into a solution so prepared, and then breaking it off, the desired contact is effected, absorption begins, and the liquid is seen slowly rising into the tube to occupy the space vacated by the absorbed chlorine. This absorption goes on very slowly, however, because of the extreme minuteness of the surface of fluid exposed to the gas in the finely-drawn tube represented by the broken extremity. A great acceleration would evidently be obtained if the surface of contact could be extended; if, for example, we could wet the whole interior surface of the tube with the absorptive liquor.

Fig. 3.

A very simple contrivance (Fig. 3) accomplishes this object.

It consists of a caoutchouc connecter tightly fitted to the end of the tube, so as to cover and enclose its fine-drawn sealed neck. This connecter is provided with a small glass funnel, through which it can be filled with a tinted solution of soda; and has also a stop-cock, by which, when so filled, it can be closed. These arrangements being made, the fine-drawn neck is immersed in the solution, so that, on breaking it (Fig. 4), which the flexibility of the connecter allows to be easily done, the solution finds its way through the orifice into the interior of the apparatus. By suitably inclining this, the solution may be caused to extend in a film over its interior, so as to expose a widely-spread surface to the gaseous mixture. The absorption of the chlorine is thus made to proceed with greatly increased rapidity, as is evinced by the speedy ascent of a small volume of the liquid into the wide part or body of the tube. This accomplished, that end of the tube which is armed with the tap-funnel and its flexible connecter may be plunged under water, the connecter withdrawn, and the experiment continued in the ordinary way, by allowing the absorption to proceed, and the column of liquid to ascend in the tube till all the chlorine is absorbed. This is known to have taken place by the liquid ceasing to rise in the tube.

The tube is now to be more deeply immersed in the water (the receptacle for which should be a tall glass cylinder, to facilitate this part of the manipulation), until the level of the liquid within and without the tube is brought into coincidence. It is then found that the tube is just half filled with liquid; in other words, that just half its gaseous contents have been absorbed. That the absorbed gas is chlorine is readily proved by the bleaching effect exerted by it on the logwood solution.

Fig. 4.

The nature of the residuary gas is as readily demonstrated by immersing the tube more deeply in the surrounding liquid, then breaking off its upper finely-drawn point and applying to the jet of gas, thus forced out by water pressure, a lighted taper, when it immediately takes fire, and burns with the characteristic pale flame of hydrogen.

These phenomena furnish a simple and satisfactory reply to the question left unanswered by our previous experiment.

The action of sodium upon hydrochloric acid has taught us that 2 volumes of hydrochloric acid contain 1 volume of hydrogen; the electrolysis of hydrochloric acid proves that, to form hydrochloric acid, 1 volume of hydrogen combines with 1 volume of chlorine.

The two experiments, taken together, supply us with the exact points of information which our previous investigation of hydrochloric acid left deficient; so that, summing up our previous and present results, we now possess a complete and irrefragable demonstration—first, that hydrochloric acid is composed of hydrogen and chlorine; secondly, that these two elements are its sole constituents; thirdly, that they are united in equal volumes to form it; and, lastly, that, in so uniting, they undergo no condensation, but produce a volume of compound gas equal to the sum of the volumes of its elementary constituents.

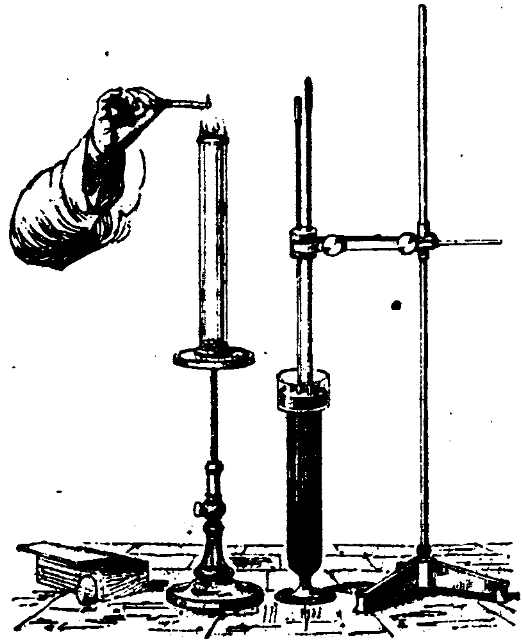
This last-mentioned fact—the union of hydrogen and chlorine without contraction or expansion—may be illustrated by another, and an equally conclusive, experiment. While the electrolytic apparatus, used in the experiment just made, is still evolving hydrogen and chlorine in the proportion in which the two gases exist in hydrochloric acid, we may replace the wide glass tube, previously used, by another tube of equal length, but of stouter glass, and of smaller bore, half a centimetre being a convenient diameter. The two ends of this tube are, like those of the tube used in the previous experiment, drawn out into very fine necks. As soon as the tube is thoroughly purged of air, and exclusively filled with the gaseous constituents of hydrochloric acid, its fine necks are sealed by the blowpipe jet, and its contents are exposed to the action of light for the purpose of inducing the combination of the mixed gases.

This effect, as is well known, may be obtained either by natural or artificial light. The direct rays of the sun produce instantaneous combination. But as such rays are not at our command in all seasons and at all places, as, for instance, during the earlier weeks of a London winter, it is necessary to employ an artificial light sufficiently intense to bring about the same effect. Such a light is that of the blue flame produced by the combustion of bisulphide of carbon in nitric oxide. The manipulation for generating this light is very simple.

For this purpose some eight or ten cubic centimetres of bisulphide of carbon are introduced into a tall glass cylinder filled with nitric oxide gas. This is most conveniently accomplished by means of a very thin bulb of glass, blown to the required size, filled with the bisulphide, and then sealed at the lamp. The glass cover of the vessel, already filled with nitric oxide gas, is drawn aside, the bulb drawn in, and the cover quickly replaced. Contact of atmospheric air is thus almost entirely obviated. The vessel is then shaken, so as to break the glass bulb, and the desired mixture of gas and vapour is at once obtained. A match is now applied to the opened mouth of the cylinder, when the mixture within takes fire, and burns with a brilliant, intensely blue flame, which descends into the vessel. The radiance of this light instantaneously induces the combination of hydrogen and chlorine; the effect being indicated by a flash of light, accompanied by a slight clicking sound, and followed immediately by the disappearance of the greenish colour of the mixture.

The figure (5) shows the disposition of the apparatus. To the left is the glass cylinder in which the light is generated; to the right are placed the mixed gases to be acted on, two tubes instead of one being filled therewith and employed in the experiment, to afford a double chance of success, since the combination occasionally fails from causes not yet perfectly ascertained.

FIG. 5.



For the purpose of examining the product, one point of the tube is broken under mercury, when the first indication is immediately obtained. It is observed that neither does gas escape from, nor mercury penetrate into, the tube; from which it is clear that the combination of the gases has taken place without either contraction or expansion of their volume.

The next indication is obtained by pouring water on the mercury, and raising the tube so that its orifice, instead of plunging into mercury, may open into water. The water no sooner comes into contact with the gas than this latter is dissolved; and so rapid is the absorption that the water rising in the tube fills it almost instantaneously. We thus obtain an additional experimental proof that hydrochloric acid is formed by the union of hydrogen and chlorine gases, in equal volumes, without condensation.

In performing this experiment, whether sunlight or the light of bisulphide of carbon be employed, some manipulatory precautions are necessary to shield the operator from possible injury by the explosion of the tubes. The experimentalist should not omit to protect himself by a screen, for which purpose a sheet of stout plate-glass may be conveniently employed. Thus, even should the tube explode, the dangerous scattering of its fragments is prevented. It is, however, only rarely that the body of the tube is shattered; in most cases the fracture is confined to one or other of the sealed points. To avoid the loss of the experiment by an accident of this kind, the upper point of the tube may be strengthened by imbedding it in sealing-wax, which may be most conveniently applied by fusing a little in a small piece of glass tube sealed at one end, and plunging the point to be protected into the fused mass, which is then allowed to cool and harden. As for the lower point, escape of gas from this, in case of rupture, is readily obviated by keeping it immersed in a trough-cylinder filled with mercury.

WATER.

The ratio in which hydrogen and oxygen are associated in water is, of course, most conveniently established by the electrolysis of this compound.

Among the numerous contrivances used for decomposing water, an apparatus constructed some time ago by Professor Buff, of Giessen, deserves to be especially mentioned. The two tubes for the collection of the gaseous constituents of the water are provided with brass stop-cocks, and plunged into a deep cylinder filled with water. As the gases are evolved, the water-level in the tubes is depressed below the level in the cylinder, and on opening the stop-cocks, the gases escaping under the pressure of the short water column may be conveniently examined.

Fig. 6 shows an improved form of this apparatus. Instead of the two stop-cock tubes separately inverted in a basin, as just described, I have adopted a three-branched tube, with one long and two short limbs. The long limb acts as a water-reservoir, instead of the basin; the two short limbs, which are fitted with stop-cocks, or nipper-taps, above, and which communicate freely with the long limb below, contain, intermediately each a platinum electrode. When this apparatus is used, the water in the short limbs is forced downward out of these so as to rise in the long limb, forming a column, the weight of which serves afterwards to expel the gas from each short limb through the corresponding stop-cock, when this is opened for the purpose of testing the nature of the gas obtained.

It now remains only to be demonstrated that two volumes of hydrogen and one volume of oxygen, when combined, yield two volumes of water-gas. This fact, familiar to us from the earliest stage of our chemical education, is, strangely enough, scarcely ever demonstrated by experiment in our lectures. As to myself, I have only since the volumetric conception of matter has acquired such predominant importance, commenced performing this experiment.

The object to be achieved is the comparison of the volume of the elementary water-constituents with that of the water formed, at a temperature high enough to maintain the latter in a purely gaseous condition.

The experiment is made in a U-tube similar to that used

Fig 6.

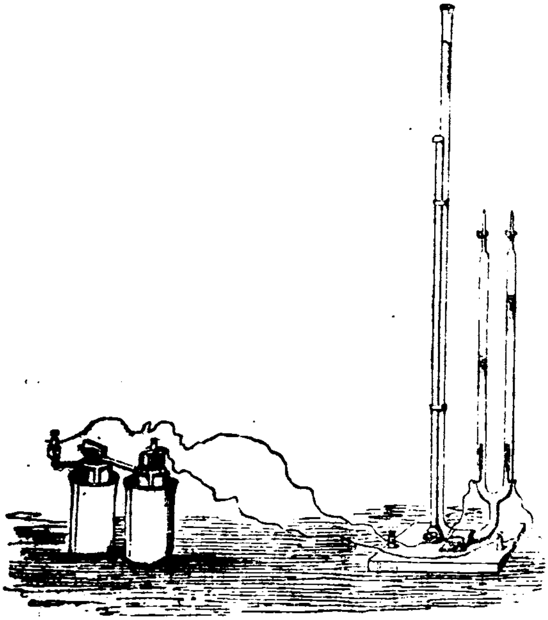
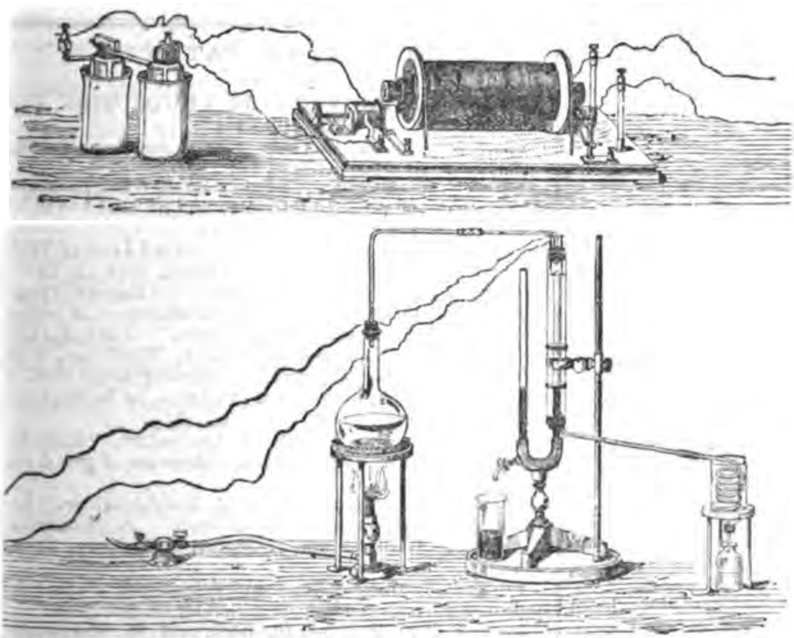


Fig. 7.



in analysing hydrochloric acid. The closed limb of the tube is, however, fitted, at a point near its sealed extremity, with two platinum wires, for the purpose of passing the electric spark; this operation I now invariably perform by means of the induction-coil.

A glance at Fig. 7 shows how this apparatus is employed. Into the sealed limb of the apparatus, which is filled with mercury, we admit a column, about 25 or 30 centimetres high, of a mixture of hydrogen and oxygen in the proportions in which they form water. This mixture may, of course, be obtained by adding two volumes of hydrogen to one of oxygen; it is, however, prepared much more readily in due volumetric proportion, and in a state of perfect purity, by the electrolysis of water. The gas-filled limb of the apparatus is surrounded by a high glass cylinder, the lower mouth of which is fastened around it by means of a perforated cork, whilst its upper mouth (likewise closed by a cork) rises about five centimetres above the sealed extremity. The annular space thus formed communicates, at its upper end, by means of a bent glass tube and a perforated cork, with a flask which contains a liquid having a boiling point considerably above that of water; amylic alcohol, which boils at 132° C., is well adapted for the experiment. On protracted ebullition, the vapour descends from the flask into the annular space, which rapidly acquires a uniform temperature of 132°. To prevent the vapours from escaping into the atmosphere, the lower extremity of the glass cylinder is connected with an appropriate vapour-condenser, such as a glass coil kept cool by water. Under the influence of heat, the column of mixed hydrogen and oxygen in the tube expands. The level of the mercury in both limbs of the apparatus having been adjusted, the height of the gas columns is now marked by any suitable means; preferably by slipping a caoutchouc ring over the outer glass cylinder. A little more mercury is then poured into the open limb, which is, lastly, closed by a well-fitting cork. Between this cork and the mercury intervenes a column of air, some eight or ten centimetres in length, and capable of yielding to pressure, like a spring. It now only remains to inflame the gaseous mixture by causing the current of the induction-coil to leap, in the form of a spark, between the platinum points. The gases combine with an explosion, which is, however, much mitigated in violence by the elastic action of the above-mentioned air column. At the high temperature employed (132°) the water formed retains the gaseous condition. On removing the cork, and allowing the mercury to flow through the nipper-tap, until it is level in both limbs, it becomes obvious that the original measure of mixed gases is diminished by one-third; the residuary two-thirds are water-gas, which condenses into liquid water so soon as the apparatus is allowed to cool.

Thus, therefore, it stands experimentally demonstrated, first, that hydrogen and oxygen undergo condensation in combining to form water; and, secondly, that the volume of the water-gas produced holds an extremely simple ratio to the volume of its constituent gases, two volumes of hydrogen and one volume of oxygen condensing, by their union, into two volumes of water-gas.

(To be continued.)

ACADEMY OF SCIENCES.

July 17.

M. Troost communicated some "*Researches on Zirconium.*" To obtain crystallised zirconium, the author heated in a retort-coke crucible to the temperature of melted iron a mixture of the double fluoride of zirconium and potassium and metallic aluminium. When the crucible was cold the surface of aluminium was found covered with crystallised lamellæ, lying one on the other, like the leaves of a book. There were crystals of zirconium. This element also exists in the graphitoidal form, the preparation of which is uncertain. M. Troost establishes that zirconium stands in the carbon group in the same position as antimony in the nitrogen group. It comes between the *metalloid* silicium and the *metal* aluminium, as antimony comes between arsenic and bismuth. The carbon group, then, is constituted as follows: — Carbon, boron, silicium, zirconium, aluminium.

NOTICES OF BOOKS.

A Letter to the Members of the British Medical Association on the Subject of their Future Journal. By R. B. Carter, F.R.C.S., etc. London. 1865.

The author of this letter is of opinion that, to advance the interests of the medical profession, it is advisable that the British Medical Association should give up their present *Medical* Journal, and publish a "Quarterly Journal of Literature, Science, and Politics." He complains that the educated public do not sufficiently appreciate the Profession, which he says has no means of influencing public opinion, and he thinks that by establishing such a journal as that mentioned above, and by dosing the public (gently at first) with medical topics, they might be gradually brought to entertain sound views on the rights, dignities, and duties of Doctors.

As the Association is just about to meet, and the change suggested in this letter will be discussed at the meeting, we may, perhaps, as part of the public, be allowed to say a word on the matter. We say, then, that to medical politics we are profoundly indifferent. What we do feel an intense and personal interest in is the progress of the "healing art," and we believe that just as the knowledge of this is advanced, the medical profession will rise in public estimation. The question that the Association should discuss then, we think, is this,—What journal will best aid in developing and diffusing among the members sound scientific information on the art of curing disease?

A Course of Practical Chemistry; arranged for the Use of Medical Students. By William Odling, M.B., F.R.S., &c., &c. London: Longman and Co. 1865. Second Edition.

This is the second edition of a good book now greatly enlarged and improved. It is said to be specially arranged for the use of medical students, but, we need hardly say, it is equally well adapted for pharmaceutical chemists, and is indeed an excellent introduction to analysis for any students. It is worth mentioning that "the old scale of atomic weights has been exclusively employed throughout the body of the work;" and that a very useful chapter on Chemical Manipulations, which greatly increases the value of the book, now precedes the analytical part.

Annalen der Chemie und Pharmacie. June, 1865.

Hlasiwetz and Barth continue their chemical studies "*On Resins*," describing in this article the decomposition products of the action of fused alkalies on resins. They have experimented upon benzoin and dragon's blood, and also upon socotrine aloes. All these bodies, when fused with caustic potash, give paraoxybenzoic acid, $\mathrm{Ꞓ}_7\mathrm{H}_6\Theta_3$, aloes yielding the largest proportion. Dragon's blood yields, in addition, some benzoic acid, protocatechuic acid, and phloroglucin. Benzoin also gives protocatechuic and oxyphenic acids. The authors append to their paper a table of the composition of guaiacum, dragon's blood, gum, benzoin, galbanum, and aloes, the products of their dry distillation, and the results of their oxidation by potash. We hope to find room for this table at a future time.

A paper by Otto describes the "*Products arising from the Action of Sodium Amalgam on Hippuric Acid.*" These, it would appear, are two: hydrobenzuric acid, $\mathrm{Ꞓ}_{18}\mathrm{H}_{24}\mathrm{N}_2\Theta_6$, and hydrobenzyluric acid, $\mathrm{Ꞓ}_{16}\mathrm{H}_{21}\mathrm{NO}_4$. The author fully describes the relations of these bodies, and the products of their decomposition by alkalies and hydrochloric acid.

A note by H. Limpricht, "*On Phosphoric Ethyl-ether*," follows. The author's mode of preparing this body is as follows:—Sodium is dissolved in absolute alcohol, and anhydrous ether added; a quantity of oxychloride of phosphorus calculated according to the following equation—

$$3\mathrm{Ꞓ}_2\mathrm{H}_5\mathrm{Na}\Theta + \mathrm{P}\Theta\mathrm{Cl}_3 = 3\mathrm{NaCl} + \mathrm{P}(\mathrm{Ꞓ}_2\mathrm{H}_5)_3\Theta_4$$

is then added in small quantities, so that the temperature is not much raised. The liquor is filtered from the chloride of sodium, and rectified by distillation. The properties of phosphoric ether are well known to our readers.

The title of a paper by Carius sufficiently describes its contents: "*On the Occurrence of Cæsium and Rubidium in Plutonic Silicates of the Rhine Provinces.*"

In a note "*On a New Transformation of Leucin*," Dr. Kohler makes known that, when leucin is treated with dry hydrochloric acid, an atom of water is eliminated, and a new body formed, which the author proposes to call *leucinimid*. In the next paper Dr. Preu shows that when *alanin*, an analogue of leucin, is similarly treated, the same change takes place, and *lactimid* is formed.

A notice by Martius and Griess, "*On a Compound from Naphthaline Isomeric with Alizarin*," describes the compound mentioned in our reports of the Academy of Sciences as discovered by MM. P. and E. Depouilly (chloroxynaphthalic acid) whose account in the *Comptes-Rendus* is much fuller than that given here.

The other papers in this journal call for no notice.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

1585. E. T. Hughes, Chancery Lane, "Improvements in the means of producing from rosaniline blue and violet colouring matters soluble in water." A communication from P. Mounet, Lyons.—Petition recorded June 12, 1865.

1703. C. Worssam, Kingsland Road, and G. Evans, Gloucester Place, Portman Square, "An improved pulping and compressing machine for the treatment of peat as a fuel and gas for illuminating purposes."—June 26, 1865.

1716. H. G. Fairburn, St. Luke's, Middlesex, "An improved mode of combining and forming small coal or coal dust into lumps, blocks, or otherwise, to be employed for the purposes of fuel."—June 28, 1865.

1785. C. F. Claus, Fearnhead, Lancashire, "Improvements in obtaining sulphates and carbonates of potash and soda."—July 6, 1865.

1793. J. M. Macrum, Hill Street, Knightsbridge, "Improvements in the manufacture of iron." A communication from J. Williams and J. Copley, Allegheny, Penn., U.S.A.

1795. A. F. Morelle, Boulevard Sebastopol, Paris, "An improved portable pocket gas-generator or gazogene."

1797. J. Peel, Bowling, Bradford, and W. Hargreaves, Little Horton, Bradford, "Improvements in manufacturing grease from soap suds."—July 7, 1865.

1809. J. Baggs, Chancery Lane, "Improvements in the production of artificial light and in the apparatus connected therewith."

1813. R. A. Brooman, Fleet Street, "Improvements in the manufacture of cast steel."—A communication from C. Pauvert, Tarbé, France.—July 8, 1865.

1831. H. A. Dufrené, Rue de la Fidélité, Paris, "Improvements in the treatment of copper and nickel ores."—A communication from Viscount C. de Sequeville, Milan.

1833. H. A. Dufrené, Rue de la Fidélité, Paris, "An improved process for obtaining oxygen."—A communication from C. Tellier, Passy, Paris.—July 11, 1865.

1841. H. Blair, Kearsley, Lancashire, "Improvements in the production of gases from aqueous vapour and in the application thereof to heating purposes."—July 12, 1865.

Notices to Proceed.

657. R. Mushet, Belgrave House, Cheltenham, "Improvements in the manufacture of steel and homogeneous iron."—March 9, 1865.

806. M. Morgans, Brendon Hills, Somersetshire, "Improvements in the manufacture and refining of iron and steel."—March 22, 1865.

871. J. C. C. Halkett, Cranwood House, Mid Lothian, N.B., "An improvement in paints or compositions used for coating iron or wooden vessels, and other structures exposed to the action of sea-water."—March 28, 1865.

1560. J. Ferguson and R. Miller, Glasgow, N.B., "Improvements in the manufacture of steel."—June 7, 1865.

670. J. Freeman, E. G. Freeman, and C. H. Freeman, Battersea, "Improvements in the preparation of turpentines and varnishes."—Petition recorded March 10, 1865.

692. E. B. Wilson, Glasgow, N.B., "Improvements in furnaces and fire-places."—March 11, 1865.

712. R. A. Brooman, Fleet Street, "Improved processes for the production of photographic images capable of being inked with fatty inks."—A communication from C. M. T. du Motay and C. R. Maréchal, Metz, France.—March 14, 1865.

729. A. P. Price, Lincoln's Inn Fields, Middlesex, "Improvements in obtaining sulphurous acids."—March 15, 1865.

855. W. Clark, Chancery Lane, "Improvements in the manufacture or preparation of materials for, and in their application to, lighting and heating purposes; also in apparatus used for the same." A communication from A. de Peyrouny, Boulevart St. Martin, Paris.—March 25, 1865.

1456. R. A. Brooman, Fleet Street, "A new method of manufacturing oil from fatty matters, or the residuum arising from the distillation of fatty matters, the manufacture of stearic acid, soap, and purification of oils." A communication from P. R. Beaumont, Paris.—May 27, 1865.

1719. W. E. Newton, Chancery Lane, "Improvements in the preparation of amalgams of quicksilver or mercury, and in the application of such amalgams to various purposes in the arts." A communication from H. Wurtz, New York, U.S.A.—June 28, 1865.

CORRESPONDENCE.

Continental Science.

Paris, July 24.

It is now settled definitely that the Great Exhibition of 1867 will be held in a temporary building to be erected on the Champ de Mars. This being decided, it is unnecessary to refer to a scheme emanating, I believe, from M. Silbermann, who proposed to exhibit the different classes of manufacture in separate buildings, to be erected at intervals along the Boulevards, and so bring the Exhibition nearer the homes and within the means of the working classes of Paris. This plan is not without its recommendations, but here as in London people will have a grand show, and, moreover, we have an architect who wishes to give us a glass dome which will reduce those of Captain Fowke to insignificance.

A vinegar-making polyp from China has just been added to the collection of objects at the Jardin d'Acclimatation. This animal is described by Father Huc in his work on China. It is placed by the Chinese in weak spirit and water, which in the course of a month or so it transforms into vinegar. No experiment has yet been made here to test the truth of this story, the polyp being still in the water in which it arrived.

At the last meeting of the Photographic Society M. Couvreux recommended the use of chloride of calcium for salting paper, the excess of which, he says, is very easily got rid of after the paper has been in the silver bath. M. Meynier read a paper strongly recommending the use of sulphocyanide of ammonium in place of hyposulphite of soda. The sulphocyanide, he affirms, leaves no objectionable sulphur compound in the paper. The same gentleman recommended the use of a double nitrate of silver and ammonia, instead of adding ammonia to a nitrate bath. M. Leon Vidal has published a set of photometric tables, and what he calls a photometer. The object of these is to tell inexperienced photographers how long to expose. In order to do this the experimenter has first to expose a strip of sensitised paper for one minute, and then compare the colour with the "photometer," which is a card having fixed upon it the ten graduated shades through which chloride of silver passes in the course of one minute's exposure to full sunlight. And now knowing the number of the shade of colour on the photometer, the focal distance of the objective, and the size of the diaphragm, the operator on referring to the tables will be told the exact time necessary for the exposure.

Skeleton Leaves.

To the Editor of the Chemical News.

Sir,—A "Constant Reader," who in a late number of the Chemical News expressed a wish to hear of a ready method of obtaining "skeleton leaves," may try my plan:

First dip the leaves in boiling water, and then immerse them in dilute sulphuric acid containing from 10 to 30 per cent. of the acid, according to the delicacy or coarseness of the leaf-structure. In a day or two use a pretty stiff bristle brush to the leaves, adding drop by drop a little saturated solution of bichromate of potassium. When the operation seems complete, wash the leaves carefully in ammoniated water, and finish with a little weak hypochlorite of calcium or chlorine water. The "skeletons" may be plated by being dipped into a very weak solution of phosphorus in bisulphide of carbon, dried, placed in a neutral solution of nitrate of silver for fifteen minutes, dried again, and lastly covered with dead silver in a small electro-plating apparatus.

An almost equally beautiful result is produced if the "skeletons" are dipped into a clear boiling saturated solution of iodide of lead. When dry they appear as if frosted with gold. If cautiously painted with a very concentrated alcoholic solution of mauve, skeleton leaves present the appearance of a magnificent and delicate casting in bronze. I am, &c.,

Wentworth E. Scott, F.C.S.

On the Estimation of Uric Acid.

To the Editor of the Chemical News.

Sir,—Since the publication of my paper on uric acid in the *Lancet*, and of which you were good enough to give an abstract in the Chemical News of July 22nd, I have made some further observations, the purport of which I desire should be known.

Dr. Odling, a short time since, suggested to me that it would be desirable that the precipitates obtained by me should be dissolved in alkali and the uric acid reprecipitated with hydrochloric acid, in order that it might be procured in a purer condition. This proceeding I have adopted in several cases, and with the following results; it being remembered, however, that my precipitates were treated with boiling alcohol of specific gravity 810·5, in order to free them from various impurities, and that the amount of mineral matter contained in them was ascertained in all cases and deducted.

The urine of twenty-four hours, obtained from the same case on two consecutive days, yielded deposits which, after treatment with alcohol and deduction of mineral matter, amounted to 21·60 and 20·65 grains, and these furnished on reprecipitation 16·36 and 16·51 grains respectively of uric acid, which, on examination with the microscope, was ascertained to be in its usual exceedingly characteristic crystalline condition.

In another case, the precipitates similarly treated amounted to 14·97 and 13·97 grains, which furnished on reprecipitation 11·85 and 12·50 grains of uric acid in crystals.

Lastly, a deposit obtained by the evaporation of nine different urines, weighing after the usual treatment 30·15 grains, gave on reprecipitation 24·36 grains.

These results are important in two respects; they show, first, that a reduction must be made from the amounts obtained after treatment with alcohol and deduction of the ash, but they also prove conclusively, when considered in connection with the quantities given in my paper already referred to, that the amount of uric acid contained in human urine is greatly in excess of that hitherto obtained, being, in fact, about double.

In addition, therefore, to the recommendations already given for the estimation of uric acid, I would advise that the precipitate should in all cases, after treatment with alcohol, be dissolved in as small a quantity as possible of a solution of potash, filtered to separate the insoluble matter, and the uric acid reprecipitated with a slight excess of hydrochloric acid.

The boiling with alcohol must be effectual, otherwise some hippuric acid may remain behind on the filter, when there will be danger of its precipitation on the addition of the hydrochloric acid. I am, &c.

Arthur H. Hassall, M.D.

Wimpole-street, 25th July.

MISCELLANEOUS.

Poisoning by Atropine. — A surgeon named Sprague, at Ashburton, is in custody on the charge of attempting to poison his wife and several other persons by placing atropine in a rabbit-pie. The presence of atropine in the pie was proved by Mr. Herapath, and the evidence of the medical man called to attend the sufferers described the symptoms of poisoning by belladonna.

Processes of Disinfection.—The following memoranda on disinfection have just been issued by the Privy Council; and, considering the circumstances under which they are published, we feel bound to assist in giving them all publicity:—

"1. For purposes of artificial disinfection, the agents which most commonly prove useful are—chloride of lime, quicklime, and Condy's manganic compounds. Metallic salts—especially perchloride of iron, sulphate of iron, and chloride of zinc, are, under some circumstances, applicable. In certain cases chlorine gas or sulphurous acid gas may advantageously be used; and, in certain other cases, powdered charcoal or fresh earth.

"2. If perchloride of iron or chloride of zinc be used the common concentrated solution may be diluted with eight or ten times its bulk of water. Sulphate of iron or chloride of lime may be used in the proportion of a pound to a gallon of water, taking care that the water completely dissolves the sulphate of iron, or has the chloride of lime thoroughly mixed with it. Condy's stronger fluid (red) may be diluted with fifty times its bulk of water; his weaker fluid (green) with thirty times its bulk of water. Where the matters requiring to be disinfected are matters having an offensive smell the disinfectant should be used till this smell has entirely ceased.

"3. In the ordinary emptying of privies or cesspools, use may be made of perchloride of iron or chloride of zinc, or of sulphate of iron. But where disease is present, it is best to use chloride of lime or Condy's fluid. Where it is desirable to disinfect, before throwing away, the evacuations from the bowels of persons suffering from certain diseases, the disinfectant should be put into the night-stool or bed-pan when about to be used by the patient.

"4. Heaps of manure or of other filth, if it be impossible or inexpedient to remove them, should be covered to the depth of two or three inches with a layer of freshly burnt vegetable charcoal in powder. Freshly burnt lime may be used in the same way, but is less effectual than charcoal. If neither charcoal nor lime be at hand, the filth should be covered with a layer some inches thick of clean dry earth.

"5. Earth, near dwellings, if it has become offensive or foul by the soakage of decaying animal or vegetable matter, should be treated on the same plan.

"6. Drains and ditches are best treated with chloride of lime, or with Condy's fluid, or with perchloride of iron. A pound of good chloride of lime will generally well suffice to disinfect 1000 gallons of running sewage; but, of course, the quantity of disinfectant required will depend upon the amount of filth in the fluid to be disinfected.

"7. Linen and washing apparel requiring to be disinfected should without delay be set to soak in water containing per gallon about an ounce either of chloride of lime or of Condy's red fluid. The latter, as not being corrosive, is preferable. Or the articles in question may be plunged at once into boiling water, and afterwards when at wash be actually boiled in the washing water.

"8. Woollens, bedding, or clothing, which cannot be washed, may be disinfected by exposure for two or more hours in chambers constructed for the purpose to a temperature of 210 to 250 degs. Fahrenheit.

"9. For the disinfection of interiors of houses, the ceilings and walls should be washed with quick-lime water. The wood-work should be well cleansed with soap and water, and subsequently washed with a solution of chloride of lime, about two ounces to the gallon.

"10. A room, no longer occupied, may be disinfected by sulphurous acid gas, or chlorine gas—the first by burning in the room an ounce or two of flowers of sulphur in a pipkin; the second, by setting in the room a dish containing a quarter of a pound of finely-powdered black oxide of manganese, over which is poured half-a-pint of muriatic acid, previously mixed with a quarter of a pint of water. In either case the doors, chimney, and windows of the room must be kept carefully closed during the process, which lasts for several hours."

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. XI. of the Chemical News, containing a copious Index, is now ready, price 11s. 0d., by post, 11s. 6d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. XII. commenced on July 7, 1865, and will be complete in 26 numbers.

J. D. O.—We gave our correspondent the best information in our power. Manufacturers, of course, keep their results to themselves, and small experiments are of no value in determining such questions.

Inquirer.—Twenty degrees Baumé corresponds to the density 1·161. Twaddell is not used in France.

A Simple Molecule.—The first week in November. Send your name, and give your subjects to the Secretary of Science and Art Department, South Kensington, before October 15.

Received.—Chemistry as a Branch of General and Practical Education. By Dr. T. Wood, F.C.S.

Received with thanks.—L. R. Darling.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Chlorides of Tungsten,[*] *by M.* H. DEBRAY.

I. BY passing a current of dry chlorine on tungsten heated to dull redness in a hard glass tube, intensely red vapours are obtained, which condense into a dark grey liquid mass. This product is a mixture of perchloride of tungsten, WCl_3, and of subchloride, W_2Cl_5 (W = 92, Cl = 35·5). It must be distilled in a current of chlorine to produce perchloride of tungsten as pure as possible; but, however obtained, this product is never wholly free from subchloride. It is, however, present in such small quantities as not sensibly to alter the composition of the perchloride. By dissolving this body in potash hydrogen is disengaged (2 to 3 cubic centimetres from 4 to 5 grammes of material). Ammonia also dissolves perchloride, giving a yellow liquid, which soon becomes turbid and decolourises, depositing brown oxide of tungsten. With ammonia only a trace of gas is disengaged. In contact with water, the perchloride, distilled in chlorine, alters slightly and is transformed, first into a white substance, then into yellow tungstic acid, without producing at all the blue oxide of tungsten, corresponding to the chloride W_2Cl_5. This is because the smallest quantity of oxygen dissolved in water suffices to transform the oxide into tungstic acid.

When, on the contrary, chloride, not distilled in chlorine, is placed in contact with water, the decomposition may be instantaneous, and in every case blue oxide of tungsten, mixed with a more or less considerable quantity of tungstic acid, is obtained.

Perchloride of tungsten offers, then, like monohydrated sulphuric acid, an instance of a body sensibly decomposing at its boiling point, giving a product the composition of which, though constant under fixed pressure,[†] can be expressed by no simple equivalent formula.

II. There are two oxychlorides of tungsten corresponding to tungstic acid. One, which is red, has for formula $WOCl_2$; the other, yellowish white, has WO_2Cl. A mixture of these two is generally obtained at the same time as tungstic acid by passing a current of chlorine on the anhydrous oxide WO_2. They are then separated by distillation, the red chloride being more volatile than the white.

I easily obtain these two oxychlorides by distilling perchloride of tungsten with a sufficient weight of dry or ordinary oxalic acid. This, it will be seen, is the process formerly used by Gerhardt for quickly preparing oxychloride of phosphorus with perchloride. Pure red oxychloride may be obtained, but whatever the method employed yellow oxychloride will always be mixed with tungstic acid or red oxychloride, because a large portion of the oxychloride WO_2Cl decomposes when it is distilled into tungstic acid and red oxychloride, as represented by the equation,

$$2WO_2Cl = WOCl_2 + WO_3.$$

It was this decomposition which, when observed by H. Rose, caused him to discover the true nature of the yellow oxychloride, which had till then been regarded as perchloride of tungsten, because water transformed it into tungstic acid.[‡] It is equally on account of this property that the mixture of oxychlorides and tungstic acid is obtained by the action of chlorine on oxide of tungsten WO_2.

It was of importance to decide whether it were possible to obtain oxychlorides by treating perchloride of tungsten WCl_3 with anhydrous tungstic acid. Experiment shows that the combination of the two bodies is effected with disengagement of heat. There is, for instance, $WO_3 + 2WCl_3 = 3WOCl_2$.

From a theoretical point of view, this reaction has a peculiar interest,[§] on which it is not here necessary to enlarge.

III. I have not hitherto been able to obtain, even approximately, the density of yellow oxychloride; its easy decomposition has rendered all my determinations so uncertain, that it has been impossible to arrive at any conclusion. It is, on the contrary, very easy to determine that of the other two chlorides, in the vapour of mercury or sulphur, for the least volatile of the two, the perchloride, distils towards 300 degrees.

The following are the results of my experiments:—

Perchloride WCl_3 in vapour of mercury.
D = 11·50.

WCl_3 in vapour of sulphur.
1st experiment D = 11·89.
2nd „ D = 11·80.
3rd „ D = 11·69.

$WOCl_2$ in vapour of sulphur.
D = 10·27.

Oxychloride $WOCl_2$ in mercury.
1st experiment D = 10·87.
2nd „ D = 10·70.

If it be desired to make the formula correspond to 2 or 4 volumes of vapour, it is found by a very simple calculation:—1st, that the theoretical density of the chloride vapour WCl_3 is D = 13·75, supposing the symbol WCl_3 corresponds to 2 volumes, and D = 6·875 supposing it to correspond to 4 volumes; 2nd, that the theoretical density of chloride $WOCl_2$ is D = 11·86 in the case of 2 volumes, and 5·93 in that of 4 volumes. These numbers, it will be observed, are very different from those furnished by experiment.

If, with M. Persoz, we assign to tungsten the formula $W'Cl_5$ (granting $W' = \frac{5}{3} W = \frac{5}{3} 92$), the equivalent of the chloride becomes $\frac{5}{3}$rds of the old equivalent; were $W'Cl_5$ supposed to correspond to 4 volumes of vapour, the theoretical density of this chloride would be D = 11·46—a number very near those given by experiment.

But then $W'O_{\frac{5}{3}}Cl_{\frac{5}{3}}$ must be admitted as the formula of red oxychloride; its theoretical vapour density, supposing this formiate to correspond to 4 volumes, would be D = 9·87, which agrees very well with the numbers given above for this chloride. But such a formula is contrary to the generally-received ideas, and it is better to do away with fractional exponents; the formula of red oxychloride must then be given as $W'_3O_5Cl_{10}$; or, $W'O_5 + 2W'Cl_5$, which is tantamount to admitting that there exist bodies the vapour-density of which corresponds to 12 volumes. I mention this difficulty without attempting to grapple with it. I hope to continue my researches, which I propose extending to chlorides of molybdenum, and to have the honour of laying the results before the Academy.

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[*] *Comptes Rendus*, lx., 810.

[†] It is certain that were sulphuric acid or chloride of tungsten distilled under variable degrees of pressure, products of equally variable composition would be obtained, as M. Roscoe has proved to be the case with the hydrates of nitric and hydrochloric acids.

[‡] *Annales de Chimie et de Physique*, lxvi., 213.

[§] According to M. Persoz, anhydrous phosphoric acid and perchloride of phosphorus also combine directly, giving oxychloride.—(*Annales de Chemie et de Physique*, l., 109.)

PHOTOGRAPHY.

Astronomical Photography, by LEWIS M. RUTHERFURD.

MY present observatory is a circular brick building of twenty feet internal diameter, with a light revolving roof supported on twelve wheels which are fixed to the stone coping of the walls.

The opening, two feet wide, extends from side to side with simple shutters, which, when elevated on the weather side, serve to prevent the wind from blowing into the observatory and shaking the telescope. Opening from the west side of the equatorial dome is a small transit apartment with computing room attached. This observatory is in the garden of the house where I reside. The transit is 189 feet N.W. from the Second Avenue, and 76·3 feet N.E. from Eleventh Street. It was erected in the summer and autumn of the year 1856. The equatorial, by Fitz, is a very substantial instrument, having circles divided on silver 18 and 20 inches in diameter.

The objective is of 11¼ inches aperture, and 14 feet focal length, and was corrected for figure by myself after the methods and directions of Mr. Fitz. It is a fine glass, capable of showing any object which should be seen by a well corrected objective of those dimensions.

The observatory is low, and therefore cannot reach any object near the horizon, but I prefer losing such observations to the tremors and expense of a high structure.

The transit room has been used on several occasions by the U.S. Coast Survey in their telegraphic operations for longitude. It is 0h. 12m. 15·47s. E. of Washington, and in latitude 40°, 43′, 48″·53; the latitude being the result of observations with the zenith telescope upon twenty-four pairs of stars by the observers of the Coast Survey.

During the winter of 1857—58, Messrs. Alvan Clark and Sons constructed, and in the spring attached to the equatorial, a driving clock of the highest merit. It has a remontoir escapement similar to that of Bond's spring governor.

Having seen with great interest the photographic experiments conducted at the observatory of Harvard College, I determined, as soon as the clock should be in working order, to prosecute the subject of celestial photography. After many experiments it was ascertained that the best photographic focus of the objective was about $\frac{1}{10}$ths of an inch outside the visual focus. I continued making photographs of the moon and such stars as could be obtained, and although when compared with what had been done by others the results gave reason for satisfaction, yet in view of what was desirable and apparently attainable, astronomical photography with me was a failure. By reducing the aperture of the telescope to five inches for the full moon, I was enabled to produce negatives which would bear an enlargement to five inches or fifty diameters. An impression of a sixth magnitude star was never obtained, γ Virginis, then 3″ distant, was the closest pair, the duplicity of which could be measured on the collodion plate. The ring of Saturn and the belts of Jupiter were plainly visible, but entirely unsatisfactory. An image of Jupiter could be obtained in from five to ten seconds' exposure, but the satellites failed to impress the plate in any length of time. This was due to the uncorrected condition of the objective which diffused the violet rays over a large space, so that in the case of the planet each point of the picture was influenced not only by the ray due to that point, but by the stray beams from adjoining portions of the object, and thus nearly the whole actinic force of the objective was gathered within the dimensions of the image. In the case of the satellite the lost rays were not replaced by the wanderers from any adjacent point.

During the summer of 1858 I combined my first stereograph of the moon, producing quite a satisfactory result with the low power of the stereoscope. I do not know when this was first done in England by Mr. De La Rue, but with me the idea was an original one.

My greatest success with an uncorrected objective was in the pictures of the sun taken with about one-fiftieth of a second exposure, with the aperture reduced to one inch. The negatives were four inches in diameter and exhibited the spots with reasonable sharpness, the manifest difference in light between the centre and the edge, and under favourable circumstances the faculæ. Some of the negatives verify the observation of M. Dawes, that the faculæ are elevations.

In June, 1860, the sun's disk was remarkably rich in spots, and I combined the pictures of two days to produce a stereograph, but the result was a failure and did not give the impression of a sphere, but presented the appearance of a flat uniform disk spanned by a spherical net-work which seemed entirely detached from the disk. This is attributable to a want of sufficient detail on the surface of the sun.

During the year 1859 and for a long time I worked with combinations of lenses to be inserted in the tube between the objective and the plate with the view of correcting the photographic ray. This attempt succeeded well so far as the centre of the field was concerned, but it was impossible to produce a good correction over a space equal to the area of the image of the moon, without using a corrector of inconvenient size.

In 1860 I prepared a telescope with camera and instantaneous apparatus mounted equatorially to send by the U.S. Coast Survey Expedition to Labrador for the observation of the eclipse. The objective in this case was a fine one, by Alvan Clark, of 4¼ inches aperture. A ring was placed between the crown and flint lenses of such a width that the best visual and photographic foci were united. For this purpose it was necessary to shorten the combined focus about one-twentieth of its former value.

The pictures of the sun taken with this instrument were better than those made by my large telescope, in which no attempt had been made to correct the photographic rays.

Being unable to accompany the expedition, I made a series of pictures of the eclipse at home, upon which are seen the nuclei and penumbræ of the spots, the gradation of light of the sun's disk, and the serrated edge of the moon projected upon the sun. They show, however, none of the fogging of the moon's surface commented upon by other observers, nor a greater intensity of light at the points of contact between the sun and the moon; both these results are, when they occur, due, in my opinion, to photographic or optical causes, and not to any true astronomical phenomena of that nature.

On examining the first negative of the eclipse I was struck by the difference of sharpness between the edge of the sun and that of the moon projected upon its disk. At first I was inclined to think that it was caused by a falling off in definition near the edge of the eyepiece used. In the next picture the edge of the sun was placed near the centre of the field and the moon removed to a remote part of the plate, yet still the result was the same; the sun's edge was soft and indefinite, while that of the moon was hard and sharp, showing that the light from the two objects comes to us under different conditions; in one case traversing the sun's atmosphere, in the other unaffected by this disturbing cause.

(To be continued.)

THE

DUBLIN INTERNATIONAL EXHIBITION.

By CHAS. R. C. TICHBORNE, *F.C.S., F.R.G.S.I., &c.*

(*Specially Reported for the* CHEMICAL NEWS.)

(*Continued from page 39.*)

In the French Department, Baudesson and Hauzeau show a novel application of photography—viz., photographs printed upon calico, in black, blue, magenta, and sepia; but they give no details of their process.

Dubosc and Co. exhibit extracts in the liquid and solid form for dyeing purposes. We believe that no mention of their preparations was given in any of the reports yet published, but they have been used with some considerable success in the Manchester houses. The liquid extracts would, in the writer's opinion, be open to the objection that the actual amount of tinctural value will probably vary very much in different samples. This will not apply so much to the solid extracts. The one examined by the author (Persian berries) gave a bright solution and left no residue. The value of these preparations will, of course, depend upon the prices, taken in connection with their dyeing strength.

The celebrated firm Tissier and Sons show bromine and iodine, and bromides and iodides. There is a remarkably fine specimen of bromide of potassium, if it is pure. But these specimens are shown as commercial ones, and, therefore, probably the bromide contains a little iodine. At least, it is a fact that a small quantity of iodide of potassium makes the bromide crystallise in much larger crystals.

Italy shows some beautiful crystals of native sulphur exhibited by Federico Lancia, Duke of Brolo; also some very fine specimens of worked sulphur are exhibited in Section 1. The rolls of sulphur differ in form, being more conical than those found in our commerce. There is also in this Section a very interesting series sent by the directors of the Mont Cenis railway tunnel through the Alps. These are a series of specimens of the rock met with in the Mont Cenis tunnel taken at equal distances apart both on the Bardonnêche and Modane entrances; they are taken at a distance of 200 metres apart. They therefore serve to illustrate the internal geological structure of the Alps in the province of Turin.

Mannite, or sugar of mushrooms ($C_6H_{14}O_6$), occurs very generally diffused through the vegetable kingdom. Professor de Luca, of the Royal University of Naples, has shown that mannite is present in all parts of the olive tree, and sends some beautiful specimens crystallising in prisms from all parts of the tree. Thus we have specimens from the green leaves, from the yellow leaves, from the flowers, from the unripe olive, and from the olive just commencing to ripen. Professor Luca says that mannite exists in every part of the olive tree—the leaves, flowers, and fruit containing the greatest quantity; the roots, wood, bark, and branches rather less. This saccharine principle is not always found in the same quantity at all stages of vegetation. At the period of blossoming it accumulates in the flowers and diminished in the leaves; the fallen flowers having once completes the phenomenon of fecungation, no longer contain any mannite. It has likewise been found, says De Luca, impossible to obtain the slightest traces of it in the yellow, fallen leaves. Mannite exists in the fruit as long as it continues green, diminishing in proportion as it ripens, and disappears entirely when it becomes perfectly ripe, and contains the greatest quantity of oil.

The chlorophyle which accompanies the mannite seems to follow its changes; the leaves are never devoid of more or less mannite as long as they continue green, but the mannite diminishes as it turns yellow.

De Luca has published a table showing the analysis of the olive leaves during six months in the year.

No. 28 in Section 2 is a curious and interesting product. It is exhibited by Ciaranfi, of Florence, and the Convent of the Servite Friars. It is crystallised bicarbonate of potassium, obtained by submitting a solution of commercial potash to the action of the carbonic anhydride evolved spontaneously and in great abundance from the mineral spring of Chianciano, near Poggibonsi (Senna), and belonging to the convent. Bicarbonate of sodium, obtained by the same method, is also exhibited. They also show protocarbonate of iron obtained by the double decomposition of solutions of sulphate of iron and an alkaline carbonate, subsequently washed with distilled water, and dried in an atmosphere of the pure dry carbonic acid gas evolved from the spring of Chianciano—a process which, as the label states, could not be followed in an ordinary manufactory.

The Netherlands would hardly be well represented if they did not exhibit some madder products. The garancine and madder factory of Tiel produces a very complete collection of madder products, including alcohol procured as a bye product of the garancine process, the specific gravity being ·828. The latter article may be the cause of the compiler of the official catalogue placing this collection in Section 3 (substances used as food); otherwise we do not see the connection of this display with the said section. In the Siam and many other departments Mr. Simmonds (well known in connection with the *Technologist*) exhibits many substances which would be of interest to the chemist, but they are so numerous that we could not even attempt to pick them out of the catalogue. This gentleman seems to have succeeded in making an extraordinary collection from all parts of the world.

In Switzerland there is a splendid case by Henner and Co. containing some rare organic and other chemicals. To look at such a *recherché* collection of out of the way products as are found in this case would warm the heart of a Hofmann.

The Zollverein department, as might be imagined, is particularly rich in geological and chemical specimens. The maps displayed by the Government Boards of Mines in Bonn, Breslau, and Halle are colossal in the extreme, and are some of the finest things in this way that we have seen; but the chemical interest is brought to a focus upon viewing a case exhibited by Th. Schuchardt, which is one of the most unique things in the whole Exhibition. It consists of a collection of chemical products used in glass staining and porcelain works. Many of these specimens, we are told, are the same as are supplied to the imperial potteries at Sévres. M. Schuchardt also exhibits some vanadiates, and a very fine specimen of red chromate of lead of a most brilliant hue. Thus a fine painter's colour may be procured for about 2s. Also a specimen of borate of manganese; this is more extensively used as a siccative, two ounces being sufficient to make 1 cwt. of linseed oil drying. A very pretty series of nickel salts is displayed in this case. These, we believe, are used in glass staining more as delcolourisers than as anything else, except the chromate, which produces a fine bluish green glass. Some watch oils are exhibited in this section which were examined by one of the jurors; they consist of olein from olive oil, very neutral, and when subjected to the continuous action of a freezing mixture remained perfectly limpid, although at the same time they became viscid. Eau de Cologne is represented by no less than three firms; each of these firms states that he or she is the original. The woodstuffs prepared for paper makers are very good in this department, and superior to some exhibited in the Italian. They are made from the linden, aspen, Scotch fir, and pine, and excellent writing paper was shown containing 48 per cent. of woodstuff. *A propos* of paper, a starch manufacturer informed the writer that large quantities of starch are being manufactured now in England for paper makers. The starch is mixed cold with the pulp, and after making the paper is passed through pretty hot rollers. It will be seen that the starch granules being partially broken and converted into dextrine two objects are obtained—a saving of the expensive rag stuff, and a homogeneousness of texture.

Other Foreign Exhibitors.—Loehnert, Bohemia, dextrine.

Brasseur, Ghent, chemical products from the destructive distillation of wood.

Rocques and Bougeois, Seine, chemical products.

Antonio, Baron Cristofero Catania, essential oil of lemons, oranges, and orange flowers.

Campisi, Alfio Militello, citric acid.

Candiani, large collection of chemical products, acids (pure and commercial), ammonia, nitro-benzol, silicates, nitrate of silver, sulphate and borate of manganese, &c.

Garofolletti, Ferdinand's crystals for making black ink.

Parenti, Galgono, asparagine, caffeine, citrate of caffeine, &c., very fine.

PROCEEDINGS OF SOCIETIES.

COLLEGE OF PHYSICIANS.

Friday, April 28, 1865.

"*On Animal Chemistry.*" A course of Six Lectures by William Odling, M.B., F.R.S., F.R.C.P.

Lecture 2.

Proximate animal and vegetable principles included in the class of organic compounds, together with the various bodies resulting from their natural and artificial metamorphoses—Carbon the characteristic element of organic compounds—Number, variety, and complexity of its combinations with hydrogen and oxygen—Highly complex organic bodies built up of less complex molecules—Salicine formed of saligenine and glucose; populine of benzoic acid, saligenine, and glucose—Occurrence of constituent molecules in an incomplete state—Doctrine of residues—Existence of minute residues of acetic acid and ammonia in acetonitrile, and of oxalic acid and ammonia in cyanogen—Residues of constituent molecules ever ready to regenerate complete and separate molecules by an absorption of water—Aplone molecules possessed of simple constitution, or associated with bodies of simple constitution as members of the same family—Distribution of aplone molecules into series of similarly constituted compounds—Their distribution also into groups of dissimilarly constituted compounds susceptible of mutual metamorphosis—Series of primary fatty acids—Acetic, propionic, and butyric groups—Relations of alcohols and glycols to mono- and di-basic acids—Nature of homologous series—Differences and resemblances between the fatty acids—Series of aromatic acids and hydrocarbons—Other groups and series—Possibility of referring every aplone molecule to a definite position in some homologous series and heterologous grouping—Hippuric acid formed of three constituent residues convertible into complete molecules by an absorption of water—Assignment of these molecules to their appropriate positions in groups and series—Possibility of obtaining any two residues in combination, by destruction or removal of third—Benzamide formed by destruction of glycolic residue, benzoglycolic acid by destruction of ammonia residue, and glycocine by removal of benzoic residue—Assumed pre-existence of benzamide, benzoglycolic acid, and glycocine in hippuric acid—Probable internal arrangement of the acid—Illustrative animal products formed of two constituent residues—Urea, glycocine, leucine—Spermaceti and myricin the analogues of acetic ether—The true fats—Illustrative animal products formed of more than two residues—Taurine, sarcosine, alloxan, and the biliary acids—Scheme of the constitution of kreatine.

Chemists have ascertained that the various tissues of plants and animals are composed of, or contain, a great number of distinct chemical compounds, capable, for the most part, of being separated from one another by what may be regarded as physical processes—that is to say, by processes dependent on differences of volatility, fusibility, solubility in different menstrua, &c. These several compounds have either been built up in the living plant or animal, or have been formed spontaneously in the dead plant or animal out of ancestral substances which were built up in the living plant or animal. Somehow or other these proximate animal and vegetable principles, as they are termed, have been produced through the agency of vitality. They have been formed through the intervention of a living organism, and are hence called organic compounds, in contradistinction to such substances as quartz and feldspar and hæmatite, which pre-exist in the mineral kingdom, and from such substances as copperas and alum and carbonate of soda, which are produced artificially by human ingenuity out of the pre-existing compounds of the mineral kingdom.

When the chemist gets hold of these different tissue products and components he submits them to a variety of experiments, and subjects them to the most strange transformations; he performs a simple subtraction by taking away certain constituent atoms and leaving the remainder; or he performs a simple addition by introducing fresh constituent atoms, whether of a similar or a different nature; or he performs a substitution, taking away certain constituent atoms and introducing fresh ones in their places; or he effects a more or less complete decomposition, by breaking up the substance into a variety of less complex bodies. Now, all these products into which the chemist transforms the proximate vegetable and animal principles, of which we have spoken, belong to the class of organic compounds. As a rule, they do not pre-exist in living organisms, they are not formed spontaneously in dead organisms, but they result from the skill of the chemist operating upon compounds which were formed at some time or other through the agency of living organisms. Just as the alum and carbonate of soda which the chemist manufactures out of native minerals belong to the class of mineral compounds, so do such substances as chloroform and aniline and cyanuric acid, which the chemist manufactures out of the proximate principles of plants and animals, belong to the class of organic compounds.

It is found that all organic compounds, whether of natural or artificial production, contain carbon as an essential constituent, nearly all of them contain hydrogen also, while the great majority consist of carbon, hydrogen, and oxygen. In my last lecture I brought under your notice certain nitrogenous products of tissue metamorphosis, but confining our present attention to such organic bodies as consist of carbon, hydrogen, and oxygen, or of carbon and hydrogen only, I would speak to you, in the first place, of their immense number and variety. If we take any three elements whatsoever, exclusive of carbon, we shall find that by their mutual combinations they very rarely indeed form more than half-a-dozen definite and distinct compounds; but we are acquainted with some thousands of compounds composed solely of carbon, hydrogen, and oxygen united with one another in different quantities and proportions; which thousands of compounds differ most strikingly in their properties, but were all originally produced in living organisms, or made artificially by a transformation of the compounds originally produced in living organisms.

In addition to their number and variety, organic or carbon compounds are characterised by the complexity of their constitution, or by the number of constituent atoms of which their respective molecules are composed. If we take any definite mineral substance containing only three different kinds of elementary matter corresponding to the carbon, hydrogen, and oxygen of the bodies now under consideration, we shall find that the number of constituent atoms in such mineral substance very rarely indeed exceeds ten or twelve, never perhaps exceeds twenty; whereas, among organic or carbon compounds, bodies containing hundreds of constituent atoms are not unfrequently met with, a few of which compounds, by way of illustration, are written up on the table before you.

Organic Principles.

Formula.	Name.	Atoms.
$C_6H_{10}O_5$	Starch	21
$C_6H_{14}O_6$	Mannite	26
$C_{13}H_{18}O_7$	Salicine	38
$C_{20}H_{22}O_8$	Populine	50
$C_{27}H_{22}O_{17}$	Tannin	66
$C_{26}H_{44}O$	Chloresterine	71
$C_{32}H_{64}O_2$	Spermaceti	98
$C_{57}H_{110}O_6$	Stearine	173

First of all we have starch, a compound consisting of 6 atoms of carbon, 10 of hydrogen, and 5 of oxygen, making altogether 21 atoms. Next we have mannite, the crystallisable principle of ordinary manna, of which it forms, I believe, as much as 60 or 70 per cent. It consists, as shown by its formula, of 6 atoms of carbon, 14 of hydrogen, and 6 of oxygen, making altogether 26 atoms. Next we come to the crystallisable bitter principle of willow bark—namely, salicine, which, I am informed by manufacturers, is still largely produced and used as a substitute for quinine. It is characterised, as you perceive, by the red colouration it experiences when acted upon by sulphuric acid, and contains, as shown by its formula, 38 constituent atoms. Next we come to populine, a similar crystallisable principle, much less generally known and less widely distributed. It is found in its leaves and bark of the poplar, and contains 50 constituent atoms; while tannin contains 66 atoms, and cholesterine 71. I may take this opportunity of observing that cholesterine, hitherto regarded as an exclusively animal product, is now known to enjoy an extensive distribution in the vegetable kingdom, having been extracted from peas, wheat, almond oil, olive oil, &c. We pass on to spermaceti, with its 98 atoms, and, lastly, to stearine, with its 173 atoms of carbon, hydrogen, and oxygen. Comparing tri-elementary bodies of this kind with tri-elementary mineral substances in which the number of atoms seldom exceeds ten or twelve, you will see that the compounds presented for our consideration are at first sight of a highly complicated nature.

But in the majority of instances a minute chemical examination of these apparently complex organic bodies has led to the conclusion that they are formed, if I may so say, by the agglomeration of certain less complex molecules. Taking salicine and populine as illustrations, we find that salicine readily breaks up into the less complex molecules known as saligenine and glucose or grape sugar, while populine breaks up into a molecule of saligenine, a molecule of grape sugar, and a molecule of benzoic acid. I have here a specimen of saligenine or saligenic alcohol, a beautiful crystalline body, which even when in very weak solution is capable of being recognised by its action on perchloride of iron. Thus, on adding tincture of iron to a dilute solution of saligenine, we get a deep purple colour, developed by the mutual reaction of the two bodies, as you perceive. Salicine, then, by an absorption of water, breaks up into the less complex bodies saligenine and glucose, as shown in this equation—

$$\underset{\text{Salicine.}}{C_{13}H_{18}O_7} + \underset{\text{Water.}}{H_2O} = \underset{\text{Saligenine.}}{C_7H_8O_2} + \underset{\text{Glucose.}}{C_6H_{12}O_6};$$

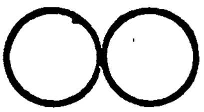
while, under similar circumstances, populine, with its fifty constituent atoms, breaks up into saligenine, glucose, and benzoic acid, thus:—

$$\underset{\text{Populine.}}{C_{20}H_{22}O_8} + \underset{\text{Water.}}{2H_2O} = \underset{\text{Saligenine.}}{C_7H_8O_2} + \underset{\text{Glucose.}}{C_6H_{12}O_6} + \underset{\text{Benzoic acid.}}{C_7H_6O_2}.$$

Confining our attention to salicine, the point I wish to impress upon you in relation to this body is, that it does not really contain either saligenine or glucose in the state of a complete molecule. Adding together the number of atoms of carbon, hydrogen, and oxygen in saligenine, and the number of atoms of the same elements in glucose, we find they are in excess of the number of atoms contained in the molecule of salicine, as shown in the table.

1 Saligenine .	$C_7H_8O_2$	1 Salicine .	$C_{13}H_{18}O_7$
1 Glucose . .	$C_6H_{12}O_6$	1 Water . .	H_2O
	$C_{13}H_{20}O_8$		$C_{13}H_{20}O_8$

Hence the necessity for the atom of water, which has to be incorporated by the salicine before it can split up into its constituents. We may say, then, that salicine does not contain either saligenine or glucose as such, but that it contains, in a state of combination, a residue of saligenin and a residue of glucose, which residues are, as it were, ever on the alert to take up water, and so produce the separate and distinct molecules saligenine and glucose respectively. If we attempted to represent the composition of salicine graphically, we should not place two complete circles in apposition side by side, thus:—


Saligenine. Glucose.

but we should place two incomplete circles, or the residues of two circles in conjunction, thus:—

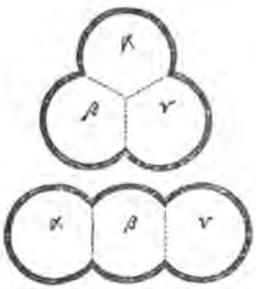

Salicine.

Similarly, with regard to populine, it does not actually contain saligenine, glucose, and benzoic acid, but is made up of the residues of these three bodies, which can only be obtained in their complete and separate state by an incorporation of the elements of water with the populine; thus:—

1 Saligenine .	$C_7H_8O_2$	1 Populine .	$C_{20}H_{22}O_8$
1 Glucose . .	$C_6H_{12}O_6$	2 Water . .	H_4O_2
1 Benzoic acid .	$C_7H_6O_2$		$C_{20}H_{26}O_{10}$
	$C_{20}H_{26}O_{10}$		

Accordingly, we should not represent populine graphically by three complete circles in apposition, but by the residues of three circles conjoined with one another, as in one or other of these figures:—

Populine.

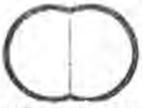


The constituent residues existing in salicine and populine form very considerable proportions of the original molecules; but in many instances these residues become extremely small. For instance, by combining acetic acid with ammonia we obtain acetate of ammonia, a salt formed by the direct union of the two complete molecules, acetic acid and ammonia. Under certain circumstances an atom of water may be eliminated from this acetate of ammonia, whereby it becomes converted into acetamide, which by the further loss of an atom of water becomes aceto-nitrile, as shown in these diagrams:—

$$\text{Acetate of Ammonia} \left\{ \begin{array}{l} C_2H_4O_2 + H_3N \\ \quad 60 + 17 = 77 \end{array} \right.$$

$$\text{Acetamide} \left\{ \begin{array}{l} C_2H_4O_2 + H_3N - H_2O \\ \quad 60 + 17 - 18 = 59 \end{array} \right.$$

$$\text{Acetonitrile} \left\{ \begin{array}{l} C_2H_4O_2 + H_3N - 2H_2O \\ \quad 60 + 17 - 36 = 41 \end{array} \right.$$



In acetamide the residues of acetic acid and ammonia contain only 59 out of 77 parts, while in aceto-nitrile they amount to only 41 parts, or little more than half the weight of the original molecule. Nevertheless, in aceto-nitrile the two small residues stand apart from another as perfect representatives of, or proxies for, the entire molecules, ready without a moment's notice to regenerate them on the concurrence of suitable conditions. Under a variety of circumstances both acetamide and aceto-nitrile absorb the elements of water with reconversion with acetate of ammonia, a body containing the complete antagonistic molecules, to which the constituent residues of the amide and nitrile alike appertain.

Let me give you one additional illustration of this doctrine of residues. Upon applying a gentle heat to certain metallic cyanides we obtain cyanogen gas, which is recognisable by the beautiful violet-coloured flame with which it burns, as you see, at the mouth of the tube. In this experiment the cyanogen gas is being made by heating a metallic cyanide, but it is capable of being produced in an entirely different manner. If, instead of combining ammonia with acetic acid, we combine it with oxalic acid, and if from the resulting oxalate of ammonia we abstract water, we thereby obtain cyanogen gas, as shown in this table:

	Name.	Formula.	At. Weight.
1	Oxalic acid	$C_2H_2O_4$	90
2	Ammonia (H_3N)	H_6N_2	34
		$C_2H_8N_2O_4$	124
4	Water (H_2O)	$H_8\ O_4$	72
	Cyanogen $(CN)_2$ C_2	N_2	52

The formula for oxalic acid is $C_2H_2O_4$, and its atomic weight is 90. With this we combine two atoms of ammonia, H_6N_2, the atomic weight of which is 34. Adding these together, we get 124 for the atomic weight of oxalate of ammonia. When from this we subtract 4 atoms or 72 parts by weight of water, we have left only two atoms of carbon from the oxalic acid, and two atoms of nitrogen from the ammonia, which exist united with one another to form two atoms, or a single molecule, of cyanogen gas, and which amount to only 52 parts out of 124, or to considerably less than half the weight of the original compound. In cyanogen gas, then, the only evidence of the original oxalic acid is carbon, and the only evidence of the original ammonia is nitrogen. Nevertheless, the constituent carbon and nitrogen of this remarkable gas, which in so many of its properties resembles certain of the elementary bodies, are not incorporated with one another, but remain apart, in the same way as do the residues of saligenine and glucose in salicine, and the residues of acetic acid and ammonia in aceto-nitrile. Accordingly we find that cyanogen gas, when dissolved in water, gradually absorbs the water necessary to reform oxalic acid and ammonia, the entire molecules of which the small residues of carbon and nitrogen are but the representatives. In cyanogen gas, no matter how produced, there is a something, however small, pertaining to oxalic acid, a something, however small, pertaining to ammonia. The two residues are not intermingled promiscuously, but remain apart, ever mindful of their distinct individualities, ever anxious to reform the complete and separate molecules from which they sprung.

The progress of organic chemistry, then, has led to the conclusion that highly complex molecules are built up of the residues of less complex molecules, which constituent residues, by a direct or indirect absorption of water, are capable of separation from one another, and reproduction in their complete and perfect state. Accordingly, we regard highly complex or polymerone bodies as compounds formed by the union of less complex or aplone bodies with one another, the union being attended by an elimination of water. Now, it appears that aplone molecules, of which our constituent residues represent greater or less portions, either have a very simple constitution, or are associated with bodies of a very simple constitution, as members of one and the same organic family. Despite their enormous number, the great majority of these molecules have been already referred to certain definite positions in certain very simple groups or series, and we have every reason to believe that, with increase of knowledge, they will all be referred in a similar manner to groups or series, such as those to which I am pointing.

Organic chemistry, then, has achieved this great analytic success. The compounds so elaborately built up by living organisms it has taken to pieces, and the pieces themselves it has arranged into natural series or groups of associated bodies—into series of bodies of similar constitution and similar properties that are not susceptible of mutual metamorphosis, or into groups of bodies of dissimilar constitution and dissimilar properties that are susceptible of mutual metamorphosis.

Here, for example, we have a series of bodies, namely, the primary monobasic fatty acids, beginning with formic acid, CH_2O_2, and ending for the present, at any rate, with melissic acid $C_{30}H_{60}O_2$. Some of these acids have, as you perceive, a very simple, others a somewhat complex, constitution, but all of them present an obvious similarity of constitution, manifest the same general reactions, and are related to one another by a regular gradation, both of properties and composition.

Monatomic Fatty Acid Series.

$C\ H_2\ O_2$	Formic.	$C_{13}H_{26}O_2$	Cocinic.
$C_2\ H_4\ O_2$	*Acetic.*	$C_{14}H_{28}O_2$	Myristic.
$C_3\ H_6\ O_2$	*Propionic.*	$C_{15}H_{30}O_2$	Benic.
$C_4\ H_8\ O_2$	*Butyric.*	$C_{16}H_{32}O_2$	Palmitic.
$C_5\ H_{10}O_2$	Valeric.	$C_{17}H_{34}O_2$	Margaric.
$C_6\ H_{12}O_2$	Caproic.	$C_{18}H_{36}O_2$	Stearic.
$C_7\ H_{14}O_2$	Enanthoic.	$C_{19}H_{38}O_2$	Balenic.
$C_8\ H_{16}O_2$	Thetic.	$C_{20}H_{40}O_2$	Arachidic.
$C_9\ H_{18}O_2$	Pelargic.	$C_{21}H_{42}O_2$	Nardic.
$C_{10}H_{20}O_2$	Rutic.	$C_{27}H_{54}O_2$	Cerotic.
$C_{11}H_{22}O_2$	Enodic.	$C_{30}H_{60}O_2$	Melissic.
$C_{12}H_{24}O_2$	Lauric.		

But in the succeeding table we have three of our primary monobasic fatty acids—namely, the second or acetic acid, the third or propionic acid, and the fourth or butyric acid associated each with a set of bodies dissimilar to the acid, and dissimilar to one another; but all containing the same number of carbon atoms as the fatty acid, and correlated with it and with one another by a susceptibility of mutual metamorphosis, to such an extent indeed, that they may almost be looked upon as varieties of one and the same primitive body.

Acetic Group.

C_2H_6	Ethene.	C_2H_4	Ethylene.
$C_2H_6\ O$	Alcohol.	C_2H_4O	Elaylic alcohol.
$C_2H_6\ O_2$	Glycol.	—	
$C_2H_4\ O$	Aldehyd.		
$C_2H_4\ O_2$	*Acetic acid.*		
$C_2H_4\ O_3$	Glycolic acid.		
$C_2H_4\ O_4$	Glyoxylic acid.		
$C_2H_2\ O_4$	Oxalic acid.		

Propionic Group.

C_3H_8	Propene.	C_3H_6	Propylene.
$C_3H_8\ O$	Propylic alcohol.	C_3H_6O	Allylic alcohol.
$C_3H_8\ O_2$	Propylic glycol.	—	
$C_3H_8\ O_3$	Glycerine.	—	
$C_3H_6\ O$	Propionic aldehyd.	C_3H_4O	Acrolic aldehyd.
$C_3H_6\ O_2$	*Propionic acid.*	$C_3H_4O_2$	Acrolic acid.
$C_3H_6\ O_3$	Lactic acid.	$C_3H_4O_3$	Pyruvic acid.
$C_3H_6\ O_4$	Glyceric acid.	—	
$C_3H_4\ O_4$	Malonic acid.	—	
$C_3H_4\ O_5$	Tartronic acid.	$C_3H_2O_5$	Mesoxalic acid.

Butyric Group.

C_4H_{10}	Butene.	C_4H_8	Butylene.
$C_4H_{10}O$	Butylic alcohol.	—	
$C_4H_{10}O_2$	Butylic glycol.	—	
$C_4H_8\ O$	Butyric aldehyd.	—	
$C_4H_8\ O_2$	*Butyric acid.*	$C_4H_6O_2$	Crotonic acid.
$C_4H_8\ O_3$	Butilactic acid.	—	
$C_4H_6\ O_4$	Succinic acid.	$C_4H_4O_4$	Fumaric acid.
$C_4H_6\ O_5$	Malic acid.	$C_4H_4O_5$	Metatartric acid.
$C_4H_6\ O_6$	Tartaric acid.	—	

Of the correlated bodies contained in groups of this description, some are extremely well known and important, while others are comparatively unknown and unimportant; whence it happens that chemists attach much more interest to certain members than to others. Thus, the principal terms of every complete organic group—such as the acetic, propionic, and butyric—to which I have just directed your attention—are, 1st, the monatomic alcohol; 2nd, the monobasic acid corresponding thereto; 3rd, the diatomic alcohol or glycol; and 4th, the dibasic acid corresponding thereto. In the 2-carbon group, for instance, we have—

C_2H_6O	Alcohol.	$C_2H_6O_2$	Glycol.
$C_2H_4O_2$	*Acetic acid.*	$C_2H_2O_4$	Oxalic acid.

The monobasic acid, you observe, differs in composition from its correlated alcohol by containing one additional atom of oxygen in place of two subtracted atoms of hydrogen; while the dibasic acid differs from its correlated glycol by containing two additional atoms of oxygen in place of four subtracted atoms of hydrogen. But even of these four principal members of every complete organic group, by far the most importance is attached to the monobasic acid, which is accordingly selected in preference to the alcohol, glycol, or dibasic acid as the characteristic term or pivot of the group. As a rule, the series of monobasic acids is more complete than that of the other terms; the bodies themselves enjoy an extensive natural distribution either in the isolated condition or in the form of constituent residues; they can be obtained in a comparatively pure state, many of them occurring as commercial products; and their properties, both as individuals and as a class, have been very carefully investigated.

(To be continued.)

ON LECTURE ILLUSTRATIONS.

By A. W. Hofmann.

A Discourse Delivered to the Members of the Chemical Society, Thursday, February 2.

(Reprinted by permission of the author from the Journal of the Chemical Society, Ser. 2, vol. iii., p. 156.)

(*Continued from page 45.*)

Ammonia.

The method of ascertaining the volume-ratio in which hydrogen and nitrogen combine to form ammonia is less simple than that which suffices for the corresponding study of hydrochloric acid and water.

For this purpose we avail ourselves of chlorine, which enables us to withdraw the hydrogen from ammonia, and set free the nitrogen; the experiment has, of course, to be made under circumstances which permit the determination with accuracy of the volume of nitrogen thus separated from a known quantity of ammonia.

A glass tube for holding chlorine, and a globe for receiving solution of ammonia, and admitting it, drop by drop, to the chlorine, constitute the requisite apparatus. The glass tube is from 1 to 1·5 metre long, sealed at one end, open at the other, and marked off by elastic caoutchouc rings slipped over it and clipping it firmly into three equal divisions. The globe (Fig. 8) has a stoppered aperture above, and a dropping tube drawn out to a narrow orifice below. This tube is fitted with a stop-cock, and passes through a perforated cork, by means of which it can be tightly fixed into the open mouth of the chlorine-tube.

Fig. 8.

The apparatus is thus employed. The long chlorine-tube having been filled with cold water and inverted over a pneumatic trough, with its mouth immersed below the water level, is filled with chlorine gas in the usual way. When full, it is still allowed to stand for about fifteen minutes over the chlorine-delivery-tube, that its interior surface may be quite freed from the chlorine-saturated water that else would remain adherent thereto. The globe, meanwhile, is filled with a strong solution of ammonia, and its stop-cock is turned so that its dropping-tube also may be filled to its very tip with this solution. The cock is then again closed and the globe stoppered; after which it is ready for connection with the chlorine-tube. To effect this connection without admission of air into the chlorine-tube requires some little care and dexterity. The globe has to be immersed in the pneumatic trough, with its dropping-tube upwards, and in this position to be brought beneath the mouth of the chlorine-tube, into which the globe-tube is inserted, and fixed firmly by means of the cork which it carries. In effecting this junction, great care must be taken not to introduce any water from the trough into the chlorine-tube. This tube, with its ammonia-globe joined to it, may now be removed from the trough, and supported in a vertical position, with the globe surmounting it. A single drop of the ammonia solution is now suffered to fall from the globe into the chlorine-tube, the stop-cock being opened for a moment for this purpose (Fig. 9). The entrance of this drop into the atmosphere of chlorine is marked by a small, lambent, yellowish-green flame at the drawn-out point of the dropping-tube. Drop by drop, at intervals of a few seconds, the ammonia solution is allowed to fall into the chlorine-tube, the ammonia of each drop being, at the instant of its contact with the chlorine, converted, with a flash of light and the formation of a dense white cloud, into hydrochloric acid and nitrogen. The addition of ammonia must be continued till the whole of the chlorine present is supplied with hydrogen at the expense of ammonia. To ensure this, the ammoniacal solution is added in excess, a column of three or four centimetres being abundantly sufficient. After a few seconds the interior of the tube is lined with a deposit of chloride of ammonium; this being soluble is readily washed down and dissolved by agitating the liquid in the tube, which now contains the whole of the nitrogen separated, except a little which remains dissolved in the liquid. This small quantity of dissolved nitrogen is easily expelled from the liquid by heat.

FIG. 9.

FIG. 10.

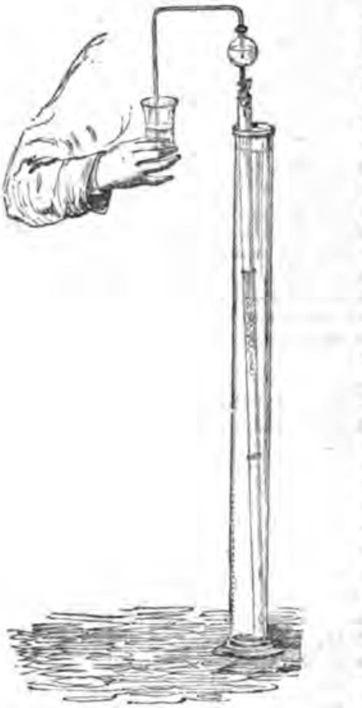
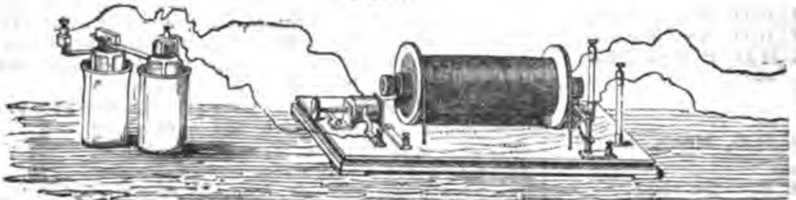
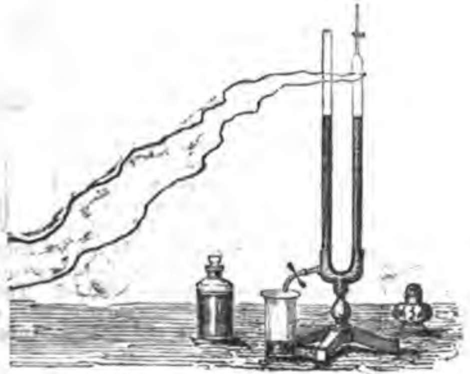


FIG. 11.





We are now sure of two points—viz., that the whole of the chlorine has been converted into hydrochloric acid at the expense of the ammonia; and, secondly, that we possess within our tube the whole of the nitrogen thus set free. It becomes our next object to withdraw the excess of ammonia. For this purpose dilute sulphuric acid, which fixes the ammonia, is introduced by means of the globe previously employed to admit ammonia. The nitrogen being thus freed from all intermixed gaseous bodies, has only now to be brought to mean atmospheric temperature and pressure in order to be ready for measurement.

The temperature, which had been raised by the application of heat to the liquid, to expel the dissolved nitrogen therefrom, is readily reduced by plunging the tube into cold water. Water must now be admitted into the tube until the pressure inside and outside is brought to a state of equilibrium. This is effected by means of a bent syphon-tube plunging into a cup of water and fixed by a cork into the globe (Fig. 10). As soon as water ceases to flow through the syphon into the tube, all the requisite conditions are fulfilled for obtaining an exact knowledge of the volume of nitrogen; and this, on inspection, is found exactly to fill one of the three divisions marked off on our tube at the outset.

Now, bearing in mind that we started with the three divisions full of chlorine, and that we have saturated this chlorine with hydrogen supplied by the ammonia; bearing in mind, moreover, that hydrogen combines with chlorine, bulk for bulk; it is evident that the one measure of nitrogen which remains in the tube has resulted from the decomposition of a quantity of ammonia containing three measures of hydrogen. It is, therefore, clearly proved by thi experiment that ammonia is formed by the union of three volumes of hydrogen with one volume of nitrogen.

Thus much determined, it remains to ascertain the condensation undergone by these elements in combining to form ammonia.

The direct synthesis of ammonia having never yet been accomplished, we must fall back upon analysis to furnish us with this demonstration. We must split up a measured quantity of ammonia into its constituents, and compare the space occupied by the ammonia before treatment with the space filled by its separated constituents. This we are enabled to do very easily, by availing ourselves of the tendency of ammonia to break up into its elements under the influence of a moderate heat. The spark-stream supplied by the electric current in traversing the induction-coil may be conveniently used as a source of heat. Among the many forms of apparatus which suggest themselves for this purpose, I find the disposition (Fig. 11) most appropriate.

The sealed limb of a U-tube is filled about one-third full with dry ammonia, over mercury, and the height of the column of gas is accurately measured, care having been taken, as usual, to bring the mercury in each limb of the tube to a uniform level. The spark-stream is now set flowing between the platinum points, and the volume of the gas on which it acts is immediately observed to increase. This dilatation continues for some five or ten minutes (according to the quantity of ammonia under treatment); and when it ceases, the level of the mercury (disturbed, of course, by the expansion of the gas) is readjusted to perfect uniformity in both limbs of the tube, when it is immediately perceived that the original volume of gas has become doubled. If a little of the gas (previously so pungent) be allowed to escape from the tube, by a stop-cock provided for that purpose, it is found to have become inodorous, while the presence of hydrogen is indicated by its inflammation on the approach of a light.

This experiment proves that hydrogen and nitrogen, as combined in ammonia, occupy only half the space they fill in their free state; or, in other words, that four volumes of the mixed gaseous constituents of ammonia, composed, as we have already ascertained, of three volumes of hydrogen and one volume of nitrogen, condense, during their combination, to form two volumes of ammonia.

Marsh-gas.

The only fact connected with the history of this compound which admits of convenient illustration is the existence in a given volume of marsh-gas of its double volume of hydrogen. This demonstration is furnished in very close approximation by the method which served us in the case of ammonia, viz., by splitting it up into its constituents under the influence of heat. This experiment we perform, as before, in a U-tube fitted up with spark wires, and as source of heat we again employ the spark-current of the induction coil. On transmitting the current the marsh-gas expands, and after the lapse of a few minutes a light deposit of carbon is formed in the vicinity of the platinum wires. The decomposition, energetic at the commencement of the experiment, proceeds more slowly as the gas dilates; but if, after fifteen or twenty minutes, the mercury be allowed to run out from the nipper-tap till it has become level in the two limbs of the U-tube, it is found that the original gas-volume has very nearly doubled. This result having been attained, the continued transmission of the spark-current produces no further increase in the volume of the gas, which is now found to consist of hydrogen.

This experiment presents greater difficulty of manipulation than either of the preceding. The spark-current, when transmitted through marsh-gas, is not unfrequently interrupted by the formation of a conducting-bridge of carbon between the platinum points. This bridge may, however, be broken by agitating the mercury in the tube until it touches the platinum wires; or its formation may be prevented by reversing the direction of the current from time to time.

With these precautions, the experiment affords very closely approximative, though not perfectly exact, results, a slight error arising from a minute proportion of marsh-gas suffering a different decomposition, so that the volume of the hydrogen obtained is never quite double that of the marsh-gas submitted to the treatment. Nevertheless, the experiment, even in this imperfect form, unequivocally demonstrates that marsh-gas contains twice its volume of hydrogen.

I have made numerous experiments with the view of finding a shorter, simpler, and, more especially, a more accurate method of exhibiting the volume of hydrogen which is present in a given bulk of marsh-gas, but hitherto without result. Eudiometrically, of course, the composition of marsh-gas is given in a single most elegant experiment, which acquires additional charm when performed at a temperature higher than that of boiling water in an apparatus similar to the one employed in determining the ratio of the volume of water-gas to that of its constituents. But at the stage of the course at which I am in the habit of examining the nature of marsh-gas, an experiment of this description is unintelligible to the student, and hence simply out of the question.

ACADEMY OF SCIENCES.

July 24.

M. **Becquerel** presented some "*New Observations on Thermo-Electric Piles of Sulphide of Copper.*" The author first described the way in which he prepared the sulphide of copper. He places a quantity of sulphur in a crucible and heats it to fusion. When this occurs, which is known by the escape of sulphur vapour, he immerses in the melted sulphur a plate of copper previously heated to dull redness, and leaves it in the crucible until all the sulphur is volatilised. He then removes the plate of copper coated with sulphide, cools it rapidly by dipping it into cold water, and finally detaches the coating of sulphide. This is then fused and run into bars or plates for the pile. As a negative element he employs *maillechort* (a nickel alloy resembling argentine). The author remarks that bars made of the same sulphide show a very unequal action, and that they should be tested before employed for a battery. In a note he mentions that Rhumkorff has found that the addition of $\frac{1}{20}$th of sulphide of antimony renders the action regular, although it somewhat diminishes the power. The ends of the bars of sulphide must be encased by the metal to prevent reduction when heat is applied direct, as by a gas flame. The author next proves that the current is developed by differences of temperature, and not by any chemical change in the sulphide, by showing that a battery has kept in action for a month with one extremity near the melting point of lead without loss of weight in the bar of sulphide of copper. M. Becquerel goes on to compare the electro motive force of this battery with other thermo electric piles, and shows that its power is much higher than that of the alloy of antimony and zinc employed by Marcus. It is only available, however, when the effects of tension are required.

M. Isidore Pierre presented a memoir entitled "*Analytical Researches on the Variations which the Relation of the Potash to the Soda undergoes in Different Parts of a Plant at Various Ages.*" The author has analysed the nodes, internodes, and leaves of wheat for alkalies at various stages of growth, and has come to the following conclusions:—1. That in these various parts of the plant the amount of potash in relation to that of the soda augments as you go from the lower to the upper portion of the stalk; and 2. That in the same parts and in the same order the relation diminishes as the plant advances towards maturity. Thus, the author argues, the salts of potash play a more important part in the life of the plant than the salts of soda. Potash predominates in the most perfect and last-developed parts of the plant, while soda accumulates in the oldest parts, which only serve a secondary or temporary purpose. He infers the uselessness of common salt as a manure for wheat. The ashes of the nodes, he states, contain 42·5 per cent. of potash.

M. Demarquay presented a note "*On the Physiological Action of Carbonic Acid.*" The author states that he has made numerous experiments on animals, on himself, and on several of his pupils, the details of which will be published shortly. He now gives his conclusions, some of which we quote. Carbonic acid exerts some exciting action on the surface of the body, particularly with a fine and very sensitive skin. The regions in which this effect is most marked are those of the penis and perinæum. Insensibility of the skin *when obtained* is only produced by a continuous jet of the gas thrown on a very limited space of the body. When injected into the veins a large quantity is absorbed and rapidly eliminated without mischief, if the operation be carefully performed. The gas acts as a slight stimulant in the alimentary canal. When breathed, it does not produce the poisonous effects commonly attributed to it. One part of carbonic acid and three parts air produces in man but slight discomfort after being breathed for some time. Most of the accidents caused by the vapour of carbon, confined air, and gases in fermenting vats, the author states, are wrongly ascribed to carbonic acid; and must be attributed to carbonic oxide, sulphuretted hydrogen, alcoholic vapours, or other gases not yet understood, which are generated under the circumstances. Respiration consists essentially of an exchange of gas between the blood and air, and this can only take, according to physical laws, between gases of a different nature. Carbonic acid being the gas to be eliminated, the exchange does not take place when the pure gas is respired, and hence asphyxia and death. From experiments on himself, the author found that the production of anæsthesia by carbonic acid is attended with danger, and, moreover, if produced, the effect is too fugitive to be utilised in surgery.

A note, by M. Naquet, "*On the Action of Perchloride of Phosphorus on Thymotic Acid,*" was read. The author's results are of no interest.

M. Hiortdahl read a note "*On the Action of Zirconia on Alkaline Carbonates.*" Zirconia at a moderate temperature easily expels carbonic acid from carbonate of soda, and forms the compound $NaOZrO_2$, which decomposes after a time in water, the zirconia separating in an amorphous condition. Heated with an excess of carbonate to a higher temperature, two equivalents of CO_2 are expelled, and the compound $2NaOZrO_2$ is formed. When this is treated with water a crystallised compound of zirconia and water separates. The author gives tables showing the quantities of carbonic acid expelled at different temperatures and different times; and also the loss experienced when carbonate of soda is heated alone, the latter table serving for corrections.

NOTICES OF BOOKS.

Zeitschrift für Analytische Chemie. Edited by Dr. C. R. Fresenius. No. 4, 1864.

This journal appears very irregularly, and this number, the last for 1864, has but recently reached us. It contains a few very useful papers which we have not seen before. The first we may notice is one by Dr. Leucanus, "*On the Transformation of Alkaline Nitrates into Chlorides.*" All analysts are aware that to change alkaline nitrates into chlorides by evaporating to dryness with an excess of hydrochloric acid it is necessary to repeat the process once or twice. With this most analysts are content, but the author shows that probably no number of evaporations would effect the complete conversion. Starting with a solution containing 0·18930 gramme of nitrate of potash, he found that after one evaporation 0·11356 of the nitrate remained undecomposed; after two evaporations, 0·05806; after three, 3·01487; and after nine, 0·00130 still remained. The evaporation repeated twelve times still left the same amount. It then became a question how to effect the perfect conversion, and the author found that by igniting the nitrate with four or six times its weight of grape sugar, thus converting the nitrate into carbonate, and then extracting the carbonaceous residue with dilute hydrochloric acid, the whole of the nitrate is found in the form of pure chloride.

Another noticeable paper is by Dr. C. Winkler, "*On the Volumetric Estimation of Cobalt.*" It contains an account of some precautions necessary to observe in making use of the author's process (C. N. vol. x., p. 215).

Dr. Hoppe-Seyler publishes "*A Contribution to the Knowledge of Albumens.*" The author describes the various forms of albumenoid matters, with their principal chemical properties. Among the albumens he classes the "amyloid substance,"—a body which Pelouze and Apjohn have found to be identical in composition with dextrine and glucose. Apjohn did find nitrogen in a specimen, but so little that he considered it an accidental impurity. The author of this paper calls it a "pathological product," and would appear to be unacquainted with the most recent researches on the nature and history of the substance. Another paper by the same author is "*On the Optical and Chemical Properties of the Colouring Matter of the Blood,*" to which we need only call attention. A method of "*Recognising Poisoning by Carbonic Oxide,*" also by Hoppe-Seyler, deserves more notice. The method is founded on the following observation:—Blood treated with carbonic oxide alone shows the same spectrum as blood containing oxygen, and, if sulphide of ammonium be added, no change will take place even after several days; but if blood which contains only oxygen in solution is treated with sulphide of ammonium, an almost immediate change takes place, and only one band is seen about midway between D and E. By this unchangeability of blood holding carbonic oxide in solution on the addition of sulphide of ammonium, the author detects the presence of the poisonous gas. It is worth quoting that the author has found that, by continuing artificial respiration for a time, animals poisoned by carbonic oxide have been restored to life, the gas being expired as carbonic acid. Another paper by the same author, "*On the Decomposition Products of Blood Globules,*" deserves the attention of physiological chemists.

A paper by Fresenius, "*Experiments on the Precipitation of Phosphoric Acid as Phosphomolybdate of Ammonia under various Circumstances,*" merits a full abstract, which we shall give in an early number.

Braun also contributes some useful analytical notes. One of them is "*A New Reaction of Cobalt,*" upon which is also founded *a new test for nitrites.* A solution of cyanide of cobalt in cyanide of potassium treated with nitrite of potash and a little acetic acid gives a deep blood red or a beautiful orange red solution, according to the strength of the cobalt solution. Further communications by the same author "*On Detecting Cobalt in Presence of Nickel,*" and "*On a Method of Separating β from α and γ Phosphoric Acids,*" we defer for a longer notice.

A paper by Habich "*On Guyard's Process for Estimating Manganese,*" communicated to the Chemical News (see vol. viii., p. 292), describes a series of experiments which confirm the value of the process with sundry precautions. The author states that the results are correct with neutral solutions. Dilute sulphuric and hydrochloric acids do not much interfere, but with a strongly acid solution the method is useless, as it is also in the presence of ferric or chromic oxide. The presence of the lower oxides of nickel and cobalt, zinc oxide, alumina, and lime, does not interfere with the results. The reports on the progress of analytical chemistry by Neubauer and Braun will furnish us with many short notices of novelties.

Bulletin Mensuel de la Société Chimique de Paris.
July, 1865.

The proceedings of the Parisian Chemical Society during the month offer nothing specially interesting. The most important papers read have been as usual communicated to the Academy, and noticed in our reports. Among the novelties we find a paper by Schutzenberger, giving the results of some researches "*On Catechine*," which lead the author to consider it probable that the true formula for this substance is $C_{22}H_{22}O_9$.

M. Lauth described "*The Reaction of Sodium upon Pure Benzine.*" Hydrogen is disengaged and a solid substance is deposited, which the author believes to be phenylide of sodium; but he found it impossible to separate it completely from sodium for analysis.

MM. Friedel and Crafts continued the account of their researches "*On Silicium Ethyl*," describing on this occasion monochlorated silicium ethyl obtained by the action of dry chlorine on the latter body. With an alcoholic solution of acetate of potash and the chlorinated body a double decomposition takes place, and an acetic compound boiling at 210° is formed. The researches of the authors, it is said, confirm the analogies which exist between carbon and silicium. The analysis of foreign memoirs contains nothing of interest which has not already been noticed in our pages.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

1818. G. J. Livesey, Old Kent Road, Surrey, "Improvements in treating ammoniacal liquors for purifying gas and other purposes."—Petition recorded July 10, 1865.

1840. A. Denayrouze, Espalion, Aveyron, "Improvements in apparatus and equipments used by persons employed under water, part of the improvements being also applicable for the use of persons employed where noxious gases or vapours prevail."—July 12, 1865.

1855. A. E. Molin, Fahlun, Sweden, "Improvements in separating gold from ores containing copper and gold." —July 14, 1865.

1875. T. Metcalf, H. Metcalf, and T. Clayton, Manchester, "An improved apparatus for cooling liquids and cooling or condensing vapours or gases."

1877. D. M'Crummen, Gourock, Renfrewshire, N.B., "An improved process of preparing sea-weeds and other vegetable substances for the production of artificial guano, felt, alkaline, salts, and iodine."

1885. G. Nimmo, Jersey, New Jersey, U.S.A., "An improvement in the mode of uniting different metals, such as iron or copper, or alloys, to form compound metallic castings."—July 19, 1865.

Notices to Proceed.

700. J. Wright, Dudley, Worcestershire, "Improvements in puddling, heating, and other furnaces."

705. F. Wise, Chandos Chambers, Adelphi, "Improvements in preparing certain colouring matters for dyeing and printing."—A communication from J. Levinstein, Berlin.—Petitions recorded March 13, 1865.

717. G. T. Bousfield, Loughborough Park, Brixton, "Improvements in apparatus for vaporising hydrocarbon liquids for illuminating and heating."—A communication from J. Griffen, Meridan, Conn., U.S.A.—March 14, 1865.

730. J. F. Brinjes, Fieldgate Street, Whitechapel, "Improvements in apparatus for cooling animal and other charcoal."—March 13, 1865.

762. T. Kenyon, Miles Platting, Manchester, "Improvements in preparing, fixing, and mordanting cloth and yarns."—March 18, 1865.

797. H. Potter, Manchester, "Improvements in treating the waste liquors obtained in bleaching certain vegetable substances."

804. A. Paraf, Glasgow, N.B., "Improvements in dyeing and printing cotton or linen fabrics or yarns."—March 22, 1865.

877. R. Young, North Frederick Street, Dublin, and C. F. O. Glasford, F.C.S., Galway, "Improvements in the preparation or treatment of seaweed, and in obtaining products therefrom."—March 28, 1865.

1785. C. F. Claus, Fearnhead, near Warrington, "Improvements in obtaining sulphates and carbonates of potash and soda."—July 6, 1865.

CORRESPONDENCE.

Continental Science.

Paris, August 1.

At the last meeting of the Academy M. Le Verrier explained the system now adopted here for collecting meteorological observations, and foretelling the weather, &c. He paid a passing tribute to the memory of Admiral Fitzroy, but did not acknowledge how much the world owes the unfortunate Admiral for the establishment of the system which M. Le Verrier would have us believe is almost his own creation. It seems that seventy dispatches from different parts of Europe arrive at M. Le Verrier's bureau between 9 and 11·30 a.m. every day. The observations in these are immediately reduced, the weather forecasts drawn, and between 12 and 1 they are telegraphed to all parts of France and various European capitals. At 2·30 p.m., the daily Bulletin is issued, and circulated to all correspondents for the cost of the paper and printing. M. Le Verrier dwelt on the necessity for combined observations, and suggested the formation of a central and European bureau for contracting the international part of the service. He quoted from Commandant Maury that Paris is best situated geographically for location of the bureau.

At a late meeting M. Dumas presented to the Academy the third volume of his edition of the works of Lavoisier. This volume contains a hitherto unedited paper, on fermentation, of which it is truly said that Lavoisier gave the first rational explanation. He determined the amounts of carbonic acid and alcohol produced in the fermentation of sugar. Lavoisier appears to have worked very hard on this subject, and it seems drew the conclusion from his analyses that sugar must be regarded as a compound of carbon and water, an idea subsequently published by Gay Lussac and Thénard. It seems, too, that Lavoisier must be regarded as the father of organic analysis. He burnt sugar by means of oxide of mercury, and collected the carbonic acid in a weighed flask of potash. This volume shows more plainly than ever how much was lost to science when that great genius went to the scaffold, not for any crime of his own, but as the representative of an obnoxious system.

You have lately noticed Dr. Tyndall's lecture on Radiation, in which he insists on the identity of heat and light. Most physicists, I believe, agree with Dr. Tyndall; but we have a dissentient here in the person of M. Baudrimont, who publishes in *Les Mondes* his reasons for believing that heat and light are two entirely distinct things. It will not be worth while going through all M. Baudrimont's arguments; but I will give one or two as specimens. Firstly, he says light does not expand bodies; heat does. Secondly, heat gives rise to various changes of state in a number of bodies, even in the deepest obscurity; it combines with these bodies, and remains with them as long as circumstances allow. Light does nothing like this, Again: M. Baudrimont asks if light and heat were identical, would it be possible to separate them as in the experiments of Melloni and Tyndall? But calorific and luminous rays, having the same refraction index, can be separated, and produce their special effects as before separation: it is absolutely impossible, then, that the two things can be identical. What, then, is light, and what is heat? Light (says M. Baudrimont) is due to vibrations of elementary atoms; heat, on the contrary, is a molecular phenomenon, produced by vibrations of the whole system which represents a molecule. In obscure heat these two orders of phenomena are separated; but when the temperature is high the movement of the molecule is extended to the constituent atoms, and light begins to appear. I need not pursue the subject further; you will find all M. Baudrimont's reasons in *Les Mondes*, together with a quiet hint from the editor that the author is fighting a windmill.

A very ingenious addition has been made to the Lenoir engine by M. Arbos. The engine would often be extremely useful where gas could not be procured, and to make coal-gas would be impracticable. In a very simple apparatus M. Arbos vaporises water, and passes the vapour over red-hot charcoal dust. The mixture of carbonic acid, carbonic oxide, and hydrogen produced is then passed through milk of lime to remove the first, and the other two go on to be mixed with air and exploded in the cylinder of the engine. Extending the use of the engine as mentioned above, M. Arbos' apparatus effects a great saving in the cost of working the machine. Gas produced for two francs will do the work of six or eight francs' worth of coal gas.

Ointment of Yellow Oxide of Mercury.

To the Editor of the Chemical News.

Sir,—I notice in the last number of the Chemical News an article "On the Yellow Oxide of Mercury Ointment as applied for Therapeutical Purposes," taken from the *Ophthalmic Review*. May I beg the favour of your calling attention to an article of my own which you will find in the *Pharmaceutical Journal* for April, 1865, and which is "On a Better Mode of Preparing Red Oxide of Mercury Ointment?" Since this paper, as I believe, first called the attention of the medical profession to the therapeutical advantages of the "yellow oxide," it may possibly have suggested the paper in the *Ophthalmic Review*; for although apparently written from Germany at the end of June, it is not too early for the author to have seen my paper, published in a largely circulated medical journal in England in the beginning of April. Indeed, in my paper I especially drew attention to the advantages that would accrue from the introduction of the yellow oxide into ophthalmic practice. As no reference is made to my name in the paper in the *Ophthalmic Review*, I trust you will regard it as only fair to give at the same time the details of my paper and the respective dates of the two communications.

I am, &c. Balmanno Squire.

12, York Place, Regent's Park, July 26.

[The abstract of Mr. Squire's paper was published in the Chemical News for March 10, 1865.—Ed. *C. N.*]

MISCELLANEOUS.

University of London.—The following is the list of gentlemen who passed the first B. Sc. pass examination:—Entire—First Division: Tempest Anderson, University College. Second Division: Sidengham Duer, private study; James Scotson, University College; Alfred Micaiah Smith, Owens College. Excluding Mathematics—First Division: William Martin, B.A., private study. Second Division: Arthur William Kay Griffith, B.A., Spring-hill College.

Spiller's Boiler Fluid (for the prevention and removal of calcareous incrustation from steam boilers).—This chemical solution, to which our attention has been drawn, has been employed for several years past in the Royal Arsenal, Woolwich, and other manufacturing branches of the War Department, besides being used successfully in many private establishments. It possesses the advantage of being perfectly soluble, so that it may be introduced into the boiler with the feed-water at any time when, from the pressure of steam, it may not be convenient to pour it through the safety valve, or other openings in the boiler. It does not exert the slightest corrosive action upon the metal plates or fittings of the boiler; but, on the contrary, has a tendency to clear off any existing rust, and preserve the iron from oxidation, whereby any slight flaws or cracks in the boiler-plate become immediately apparent—a point of great importance in connexion with the periodical inspection of the boiler. The use of this agent does not involve the introduction of a poison into the water of the boiler, so that the water drawn off may be fearlessly employed for many purposes, which, under other systems, would be attended with risk. "Mr. Spiller's Boiler Fluid" has been favourably reported upon by the Inspector of Machinery, Royal Arsenal, and other officers superintending the manufacturing departments at Woolwich. It has likewise been used with success at the Royal Gunpowder Factory, Waltham Abbey. The manager of the Royal Laboratories, Woolwich, reports (April 18, 1864) that "the chemical agent proposed by Mr. Spiller as a means of preventing incrustation in steam boilers has been tried in this department during the last two years, and found to be superior to any other boiler composition which has been used here; but it is only a partial remedy, inasmuch as it does not prevent a sediment forming in the boiler, but reduces it in quantity and keeps it in a soft pulpy state, which enables it to be the more easily removed if proper precautions are taken. The material is also advantageous in preventing rust or dirt settling about the boilers generally, thereby leaving bare whatever flaws may exist, which is a very important point."

New Method of Salting Meat.—At the last meeting of the Academy of Sciences, M. Pienkowski detailed some experiments which showed that meat salted with acetate of soda is easily dried, keeps an agreeable odour, and, moreover, is more easily *unsalted* than meat prepared with common salt.

Cochineal Colouring.—Take of best carmine ℥j., liq. ammon. fortiss. q. s., about ℥vj., macerate for a few days, and when the carmine is dissolved *gently* heat the mixture so as to drive off the excess of ammonia, taking care not to carry it too far, so as to precipitate the carmine. Put this into a wine quart bottle, add sp. vin. rect. ℥iv., sacch. alb. lbiij.; then fill up the bottle with warm water, and shake it occasionally, till the sugar is dissolved.—*R. Palmer, Phar. Journ.*

ANSWERS TO CORRESPONDENTS.

⁂ All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. *Private* letters for the Editor must be so marked.

⁂ In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

A Constant Subscriber.—The method is kept a profound secret.

W. L. C.—The article will appear very shortly.

Estimation of Uric Acid.—Erratum.—Page 48, line 7, *for* 16·36 *read* 17·36 grs.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

*Facts Relative to the Chemical Metamorphosis of Santonina,** *by M.* Fausto Sestini.

In a previous communication I had the honour of making known to the Society† the fact that solar light, by acting during one month on an alcoholic solution of santonine, transforms this substance into another, which I have called photosantonic acid; I observed that there was produced at the same time a certain quantity of a resinous matter and a little formic acid.

When pure, photosantonic acid (which would be better called photosantonina until its chemical constitution is exactly known) is colourless and transparent, with no odour, and a slightly bitter taste; it crystallises in square tables, which do not act on polarised light as does santonina.

Exposed to heat, photosantonina fuses between 64° and 65° C. It changes to a colourless transparent liquid, which, if the matter is pure, recrystallises on cooling; but if it contains any trace of resinous substance, or a little acid, it crystallises with difficulty.

These properties, shared by photosantonina with hellenina and other organic substances, led me for some time to believe it to be uncrystallisable, as I described it in my first memoir, already mentioned; and on account of this property I could not at first obtain it in a crystallised state.

To produce it in this state I isolated photosantonina from its alcoholic solution by diluting this solution, obtained by the action of solar light, with fifteen times its volume of water.

The addition of water renders the liquid milky, and on it float oily drops, which, after one or two days, take the form of white crystalline flakes, the greater number being at the bottom of the liquid. When filtered the liquid is always more or less milky; all the crystallised matter remains on the paper, and is purified by being crystallised several times, at intervals, from alcohol.

The last crystallisations furnish yellow photosantonina, on account of the resinous matter; it may be purified with a solution of caustic potash acting, in the cold, for two days on photosantonina obtained by precipitation in water; I believe that this method of purification is the most successful, having observed that alkalies notably favour the crystallisation of photosantonina.

By next saturating the alkali which has served for the purification, the resin is precipitated, coloured red, and with a bitter flavour.

When the action of the light has not been so continuous as is necessary, photosantonina is accompanied by altered santonina, easily recognisable when exposed to the sun, or when examined by a microscope with a Nichol's prism. If the substance is pure the polarised light is not coloured at all; but if it is mixed with santonina, when the prism turns, the colours of the rainbow appear and disappear on some points.

Cold water does not dissolve the least quantity of photosantonina, but boiling water dissolves sufficient to acquire a distinctly bitter taste.

Alcohol and ether dissolve large quantities of photosantonina, acquiring a very bitter taste.

I have already said that photosantonina fuses between 64° and 65° C. I must add that at 180° C. it begins to produce vapours, and that at 305° C. it boils regularly.

Exposed during 304 days at 100° C. to the air, photosantonina loses a few milligrammes of its weight, and becomes distinctly yellow; when treated by alcohol, it dissolves entirely; setting the solution to evaporate slowly, a yellow substance, apparently amorphous, is first deposited and then crystallised photosantonina. Aqueous potash dissolves the yellow matter, and leaves photosantonina; by saturating the alkali a dark red resinous substance is precipitated.

A curious phenomenon, and one for which I am as yet unable to account, takes place when photosantonina is placed in contact with concentrated nitric acid; the crystals of photosantonina immediately agglomerate, and are soon after reduced to small limpid drops floating on the surface of the nitric acid.

By diluting the nitric acid with water, the photosantonina thus liquified crystallises after a short time, and the crystals again dissolve in concentrated nitric acid. Nitric acid, diluted with its volume of water, does not liquify photosantonina; it is the same with concentrated hydrochloric acid. Both, however, are sometimes coloured slightly red when cold, but the colour disappears by heating, and I believe it depends on the presence of a trace of resinous matter, which I have observed to be coloured intense red by acids.

Monohydrated sulphuric acid first colours photosantonina orange yellow, and then entirely alters it.

Such are the results of my elementary analyses on crystallised photosantonina, and which do not entirely differ from those obtained by the analysis of uncrystallisable matters which I gave in my first communication.

The slight differences are attributable to the traces of resinous matter, from which I was unable to free them.

	Matter employed.	Carbonic acid obtained.	Water obtained.
	0·2635	0·6615	0·1975
	0·2190	0·5460	0·1700
	0·1765	0·4400	0·1430
C.	68·46	67·99	68·00
H.	8·31	8·63	9·06
O.	23·23	23·38	22·94

The crude formula $C_{23}H_{34}O_6$ would require,—

C_{23}	276	68·00
H_{34}	34	8·40
O_6	96	23·60
	406	100·00

On a Volumetric Method of Valuing Soaps,‡ *by M.* Pons.

The author remarks that the following method, which, as we have said, is Clark's test reversed, gives with sufficient exactness for commercial purposes the real value of a soap as compared with a given standard. The standard soap he chooses is mottled Marseilles, known here as Castile soap. This soap contains only 30 per cent. of water, and is free from all mineral adulterations. It has the following composition:—

Soda	6
Fatty acids	64
Water	30
	100

A gramme of such a soap, according to calculation, will be exactly neutralised by 0·1074 gram. of chloride

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* *Bulletin de la Société Chimique*, ii., 271.

† *Ibid.*, ii., 21; Chem. News, vol. x., p. 110.

‡ Abstract from *Journal de Pharm. et de Chem.*, April, 1865, p. 290.

of calcium. Therefore, a solution composed of 1·074 of chloride of calcium, and 1000 cubic centimetres of distilled water, will be neutralised by an equal volume of a second solution made of 10 grammes of the standard soap, 100 cubic centimetres of alcohol, and sufficient distilled water to make up 1000 cubic centimetres. The addition of the smallest excess of soap solution will of course give the persistent froth as in Clark's test.

M. Pons applies his process as follows:—10 cubic centimetres of the standard solution of chloride of calcium, and about 20 cubic centimetres of distilled water, are placed in a stoppered bottle, capable of holding 60 or 80 cubic centimetres. Ten grammes of the soap to be analysed are dissolved in 100 cubic centimetres of alcohol. Earthy and insoluble matters will be separated in this part of the operation, and after washing with alcohol can be weighed and analysed if required. The soap solution is now diluted with sufficient distilled water to make 1000 cubic centimetres, and the mixture is added to the lime solution from a burette graduated in cubic centimetres, and tenths of a cubic centimetre. When the persistent froth is arrived at, the amount of soap solution used is read off, and the richness of the soap experimented upon, as compared with that of the standard soap, is found by dividing 10 cubic centimetres by the number of the cubic centimetres employed. If the number used is 10 cubic centimetres, the sample is as rich as the standard; if 20 cubic centimetres are employed, the richness is only $\frac{10}{20}$ths, or 50 per cent. of the standard, and so on.

On the Supposed Nature of Air prior to the Discovery of Oxygen, by GEORGE F. RODWELL, *F.C.S.*

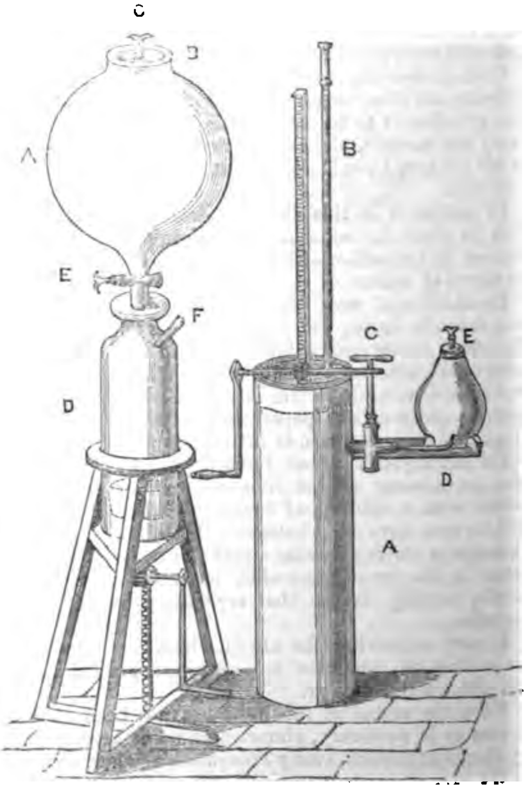
(Continued from vol. xi., page 294.)

XIII. Boyle's Second Pneumatical Treatise.—It will be remembered that Boyle's first series of "Physico-Mechanical Experiments Touching the Air" appeared in 1660; in 1661 he presented his air pump to the Royal Society, and during the five following years he undertook no lengthy pneumatical research. Occasionally, however, during this period we find mention of vacuum experiments shown by him at meetings of the Royal Society;* but now that the air pump had passed out of his possession, it is obvious that he had not the same facilities as before for carrying out a research of any magnitude.

Inasmuch as during these five years Boyle heard of only two air pumps having been constructed, and of only one or two new vacuum experiments, he determined to construct a new air pump, and to proceed further with his former experiments. With the assistance of Hooke he constructed an air pump in 1666, of different form from the first one, and in some respects superior to it. In order that the two may be compared, we have placed them side by side in the accompanying woodcut. Fig. 1 represents the instrument constructed in 1659, which was employed for the first series of experiments (described in the fourth and fifth of these papers); Fig. 2, the second air pump constructed in 1666, and employed for the experiments detailed below.

A, Fig 1, represents the receiver, a globe of glass of the very large capacity of "thirty wine quarts;" it had a circular opening above, into which was cemented a brass ring, B, closed by an accurately turned disc of brass, which fitted into it, and could be readily removed for the introduction of objects to be experimented upon; the disc was perforated, and the orifice closed by a ground brass stopper, C, by turning which, bodies within the receiver connected with it by a string could be moved when the receiver was exhausted. The lower part of the receiver communicated directly with the cylinder, D, and was furnished with a stopcock, E; a solid piston, moved by a rack and pinion, worked within the cylinder. In the upper part of the cylinder there was an orifice, into which the brass stopper, F, fitted air-tight—this served as a valve. Suppose the piston at the top of the cylinder, the stopper, F, in its place, and the stopcock, E, closed, the piston is drawn to the bottom of the cylinder (that is to say, to the position shown in the figure), and E is opened, immediately part of the air in the receiver rushes into the vacuous space in the cylinder, E is then closed so as to shut off communication between the cylinder and receiver, F is removed, and the piston forced to the top of the cylinder, the air within the latter escaping through the valve orifice; F is now replaced, and the previous operation repeated until the receiver is exhausted.

FIG. 1. FIG. 2.



A (Fig. 2) represents a cylinder of metal, furnished with a piston moved by rack and pinion. The valve (F, Fig. 1) of the 1659 air pump was in this transferred to the piston, which was perforated, and the orifice was closed by a brass stopper with a long handle, B, for the purpose of placing it in the orifice when the piston was at the bottom of the cylinder. A pipe provided with a stop cock, C, issued from the side of the cylinder, and passing along the air pump plate, D, terminated beneath the receiver, E. The piston being at the bottom of the cylinder, the stopper in its place, and the stop cock C closed, the piston is raised to the position shown in the figure, and C is opened, immediately air from the re-

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* These experiments have been detailed in the preceding paper.

ceiver flows into the vacuous space in the cylinder; C is now closed, the valve opened by raising B, and the piston forced to the bottom of the cylinder; the stopper is then replaced, and the previous operation repeated until the desired effect is produced.

The advantages of Boyle's second air pump over the first were (*a*) the diminished size of the receiver as compared with the pump barrel, whereby the exhaustion was rendered more complete, and was more quickly obtained; and (*b*) the introduction of an air pump plate, whereby the use of a globular receiver was avoided, and bodies to be experimented upon, instead of being suspended, could be placed upon a level surface, and thus during the working of the instrument did not multiply its smallest motion by swinging, as was the case when suspension was resorted to. The air pump plate was of iron, and the receiver was cemented to it, by which means Boyle managed to retain a receiver well exhausted for a length of time. The vacuum produced by the second pump appears to have been very good, of which we shall have several opportunities of judging as we proceed; the chance of leakage, moreover, was less than in the first pump. Nevertheless, the 1666 instrument had its disadvantages; like its predecessor, it fell short of Otto Guericke's pump in one respect—the valves were worked by the hand, which rendered the operation of pumping comparatively slow; it was also inferior to the 1659 air pump in one respect—the pump barrel was placed in a vessel of water, and the piston always worked under water, which not only rendered the instrument cumbersome, but not unfrequently led to water finding its way into the receiver. In describing his first air pump, Boyle mentions as a special reason why he endeavoured to construct an instrument different from Otto Guericke's that he desired to avoid the necessity of having it work under water; it is curious, therefore, that in this second pump, after further experience, he adopts that which he had previously considered so great a disadvantage.

In 1669 Boyle published a volume[†] containing an account of his new air pump, and of a number of experiments made therewith; it is written in the form of a letter, and is dated March 24, 1667. This second pneumatic treatise cannot be read with the same amount of interest as the first, for there is not only less original matter, but many of the experiments are mere repetitions of those described in the former treatise, and for the most part tend to strengthen results previously obtained, and to prove or disprove conjectures; but be it remembered we depreciate this work only as compared with the first treatise, for no research on pneumatics comparable to it had appeared since the first research of the same author, which excelled it.

We will briefly consider the more important experiments described in the second treatise:—

Experiment 1.—A phial of about five ounces capacity was partially filled with mercury; a tube four feet long open at both ends was then cemented air tight into its neck in such a manner that it reached nearly to the bottom of the phial, and consequently passed beneath the surface of the mercury; it is obvious that when the air within the phial expands, it must cause the mercury to rise in the tube. The arrangement was placed under a tall receiver, which was exhausted; when the most complete exhaustion had been attained, the mercury in the tube had risen to a height of twenty-nine inches above that in the phial. When the air vessel was very large the mercury rose no higher than twenty-nine inches, (Experiment 2); neither did variations in the diameter of the tube alter the case, (Experiment 3).

Experiment 4. Water was substituted for mercury in the above arrangement, on exhausting, it was ejected forcibly from the top of the tube by the expansion of the air in the phial—the "fountain in vacuo" of our present works on pneumatics.

Experiment 8. A bladder one fourth filled with air was securely closed, and introduced into a receiver; it was loaded with a weight of 28 lbs.; on exhausting, the expansion of the air within the bladder raised the weight.

Experiment 11. A tube 50 inches long was bent at a right angle, its upper portion was placed in air tight connection with the receiver, while its lower end dipped into a vessel of mercury; on exhausting, mercury rose to a height of 29 inches in the tube. This arrangement was afterwards applied by Hauksbee to measure the degree of rarefaction obtaining in a receiver, and is now known as the "barometer guage."

Experiment 12. In order to prove that the height to which a liquid is raised in a vacuous tube by the pressure of the external air, depends upon the specific gravity of the liquid, Boyle procured a glass U tube, the length of each limb of which was 42 inches; it was inverted, one limb was caused to dip into mercury, the other into water, and the upper part of the tube was placed in connection with the receiver; on exhausting until the water had risen to a height of 42 inches, the mercury in the other limb was found to have risen 3 inches; when strong brine was substituted for mercury, the brine column stood at 40 inches, a solution of potash stood at 30 inches, the water column being in each case at 42 inches.

Experiment 13. Into a pint bottle Boyle poured mercury and water, so that they together partially filled it; two upright tubes, open at each end, were then cemented side by side into the neck of the bottle, one reached beneath the mercury surface, and the other beneath the water surface; the arrangement was placed under a receiver; on exhausting, it was found that when the elasticity of the air in the phial had raised the mercury to a height of 1 inch in the one tube, the water had risen to a height of nearly 14 inches in the other; when the mercury was at 2 inches, the water was at nearly 28 inches.

Experiment 14. A short tube closed at one end was filled with mercury, and inverted into a vessel of mercury; a longer tube was filled with water and inverted into a vessel of water; both vessels with their tubes were placed under a tall receiver; on exhausting, it was found that when the mercury in the tube had fallen to within 3 inches of the stagnant mercury, the water column stood at 42 inches, with the mercury at 2 inches, and 1 inch respectively, the water fell to 28 and 14 inches.

Experiment 15. In order to determine the exact height to which water can be raised by a suction pump, the air pump was conveyed to the roof of a house, and a tube bent twice at a right angle was placed in airtight connexion with the receiver. The longer limb of the tube was 35 feet long, and its lower end was caused to dip into a vessel of water standing on the ground. On exhausting, the water rose to a height of 33½ feet, the mercury column in a barometer standing at 29 inches. This experiment, together with several of the above, prove the great efficiency of the 1666 air pump.

[†] "A continuation of new experiments, physico-mechanical, touching the spring and weight of the air, and their effects. Part I. By the Honble. Robert Boyle, F.R.S. Oxford, 1669."—Although dated 1669, this work was published in the latter part of 1668, as appears from the copy in possession of the Royal Society, on the title-page of which is written—"Presented from ye author to ye R. Society, Novemb. 30, 1668."

Experiment 16. In order to ascertain whether air contributes to the elasticity of solid bodies, a piece of whalebone having a weight attached to one end of it was placed in the receiver in such a manner that it supported the weight just above the air pump plate. On exhausting no alteration in the position of the weight was observable.

(To be continued.)

PHOTOGRAPHY.

Astronomical Photography, by Lewis M. Rutherfurd.

(*Continued from page 51.*)

In the autumn of 1861 I began to experiment with a reflecting telescope with silvered mirror, which recommended itself both by the simplicity and ease of its construction and the entire freedom from dispersion. One was mounted of thirteen inches aperture and eight feet focus, of the Cassegranean form. It was ground and approximately figured by Mr. Fitz, and in its frame, as strapped to my large tube and carried by the equatorial clock, weighed less than fifteen pounds. Many modes were tried of silvering, but the best results were obtained by Liebig's process, wherein the silver is deposited from an ammonia nitrate solution by sugar of milk. After three months' trial I abandoned this instrument as unfit for use in my observatory. First the tremors of the city, quite imperceptible in the achromatic, were, by the double reflection, increased about thirty-six times, an insurmountable obstacle to good work. Secondly, the silver deposit is so easily attacked, both by moisture and the gases which abound in the city, as to make it necessary to re-silver the speculum at least every ten days, a labour not to be contemplated with equanimity. Dr. Draper has found the silver surface very much more durable in the dry, pure air of the country. I regard the Cassegranean form as the best adapted to lunar photography, since the dimensions of the image can be varied at will, as circumstances dictate, by simply changing the small mirror, a number of which might be kept at hand.

Having thus failed in astronomical photography with an ordinary achromatic, with a correcting lens and with a reflector, I began, in the autumn of 1863, the construction of an objective, to be corrected solely with reference to the photographic rays.

In a former communication to this journal, January, 1863, I drew attention to the peculiar adaptation of the spectroscope as a means of examining the achromatic condition of an objective, and since it was principally by the aid of this instrument that I have been enabled to procure a fine photographic correction, I may be pardoned for touching again upon this application.

The image of a star at the focus of a perfectly corrected objective would be a point, the apex of all conceivable cones having the object glass, or parts of it, as the bases. This point falling upon a prism would be converted in a line red at one end and violet at the other, with the intermediate colours in their proper places. If, however, the different coloured rays are not all brought to the same focus, the spectrum will no longer be a line, but in the uncorrected colours will be expanded to a brush the width of which will be the diameter of the cone where intercepted by the prism. It will thus be seen that a simple glance at a star spectrum will indicate at once what parts of the spectrum are bounded by parallel lines and consequently converged to one focal point, and what parts do not conform to this condition, and also the amount of divergence.

On applying this test I found that an objective of flint and crown in which the visual was united with the photographic focus, (in other words, where the instrument could be focalised on a plate of ground glass by the eye, as in ordinary cameras, and in the heliographs constructed by Dalmayer for the Kew Observatory and for the Russian Government), is a mere compromise to convenience, in which both the visual and actinic qualities are sacrificed.

In order to bring the actinic portion of the spectrum between parallel borders, *i.e.*, to one focus, it is necessary that a given crown lens should be combined with a flint which will produce a combined focal length about one-tenth shorter than would be required to satisfy the conditions of achromatism for the eye, and in this condition the objective is entirely worthless for vision.

Having obtained the achromatic correction, I had a most delicate task to produce the correction for figure, since the judgment of the eye was useless unless entirely protected from the influence of all but the actinic rays. A cell of glass enclosing a sufficient thickness of the cupro-sulphate of ammonia, held between the eye and the eye-piece, enabled me to work for coarse corrections upon α Lyræ and Sirius, but so darkened the expanded disk of a star in and out of focus that all the final corrections were made upon tests by photography, which gave permanent record of all the irregularities of surface to be combated. Still, however, the process was long and tedious, dependent upon but three stars as tests, and they too often obscured by bad weather. My mode of correction was almost entirely of a local nature, such as practised by the late Mr. Fitz and Mr. Clark for many years.

This objective was completed about December 1 last; it has the same aperture, 11¼ inches, as the achromatic, with a few inches shorter focal length, and can be substituted for it in the tube with great ease. The corrections of this objective are such that I think it capable of picturing any object as seen, provided there be sufficient light and no atmospheric obstacles.

As respects the light, I have obtained images of stars designated by Smyth as of the 8½ magnitude, and other stars on the same plate of full a magnitude lower. In the cluster Prœsepe, within the space of one degree square twenty-three stars are taken, many of which are of the ninth magnitude, with an exposure of three minutes. An exposure of one second gives a strong impression of Castor, and the smaller star is quite visible with half a second. With the achromatic objective it was necessary to expose Castor ten seconds to obtain a satisfactory result.

The great obstacle which prevents the results of photography from realising the achievements of vision is atmospheric disturbance. In looking at an object the impression is formed from the revelations of the best moments, and it is often the case that the eye can clearly detect the duplicity of a star, although the whole object is dancing and occillating over a space greater than its distance. The photograph possesses no such power of accommodation, and the image is a mean of all the conditions during exposure. It is, therefore, only on rare nights in our climate that the picture will approach the revelations of the eye.

Since the completion of the photographic objective, but one night has occurred (March 6), with a fine atmosphere, and on that occasion the instrument was occupied with the moon; so that as yet I have not tested its powers upon the close double stars, 2″ being the nearest pair it has been tried upon. This distance is quite manageable, provided the stars are of nearly equal magnitude. The power to obtain images of the ninth magnitude stars with so moderate an aperture promises to develope and increase the application of photography to the mapping of the sidereal heavens, and in some measure to realise the hopes which have so long been deferred and disappointed.

It would not be difficult to arrange a camera box capable of exposing a surface sufficient to obtain a map of two degrees square, and with instruments of large aperture we may hope to reach much smaller stars than I have yet taken. There is also every probability that the chemistry of photography will be very much improved, and more sensitive methods devised.

On March 6 the negatives of the moon were remarkably fine, being superior in sharpness to any I have yet seen. The exposure for that phase, three days after the first quarter, is from two to three seconds, and for the full moon about one-quarter of a second.

The success of this telescopic objective has encouraged me to hope that an almost equal improvement may be made for photography in the microscope, which instrument is more favourably situated for definition than the telescope, since it is independent of atmospheric conditions. Its achromatic status is easily examined by the spectroscope, using as a star the solar image reflected from a minute globule of mercury. Mr. Wales is now constructing for me a one-tenth objective, which, upon his new plan, is to be provided with a tube so arranged as to admit of the removal of the rear combination, and, in place of the one ordinarily used, one is to be substantiated at will which shall bring to one focus the actinic rays.—*American Journal of Science*, xxxix., 304.

PROCEEDINGS OF SOCIETIES.

COLLEGE OF PHYSICIANS.

Friday, April 28, 1865.

"*On Animal Chemistry.*" A course of Six Lectures by WILLIAM ODLING, M.B., F.R.S., F.R.C.P.

LECTURE 2.

(Concluded from page 55.)

The primary monobasic acids are nearly all of them capable of being distributed into two principal series, known as the fatty and aromatic series respectively. To the series of fatty acids, beginning with the formic, acetic, and propionic acids, I have already directed your attention. You observe that each successive member of the series differs in composition from its predecessor by an increment of 1 atom of carbon and 2 atoms of hydrogen. Bodies in which this difference of CH_2 prevails are said to be homologous, and the series of fatty acids is accordingly spoken of as a homologous series. You observe (*vide* table of monatomic fatty acid series) that from the first to the twenty-first term, the series is complete, while between the twenty-first and the thirtieth terms only one intermediate acid is known, namely, the cerotic acid, an important constituent of ordinary beeswax, and especially of the Chinese wax, secreted by an insect of the coccus tribe. Now, while the difference in composition and properties, between the acids at either extremity of this series is extremely marked, that between any two or three consecutive acids, more especially of those low down in the list, is so slight as to be scarcely appreciable. Thus the formic and acetic acids when in a state of purity are perfectly mobile, strongly corrosive liquids; the butyric, valeric, and caproic acids are thin oils, while the palmitic, margaric, and stearic acids are mild inactive solids. In comparing formic acid with palmitic acid, which is only two-thirds of the way down the list, we scarcely perceive a single point of resemblance; but in comparing formic acid with the acetic, or still more decidedly in comparing palmitic acid with the margaric and stearic acids, the difficulty is rather to see the difference than the resemblance between them. Nevertheless, between the upper and lower members of the series there is a latent similarity, and indeed certain well marked properties are common to all the acids under consideration. They are all volatile, inflammable, saponifiable, monobasic, and decomposible in a similar manner under the influence of the same reagents. We are not in the habit of regarding vinegar in any form as an inflammable material, but in reality strong acetic acid is almost as inflammable as alcohol. It only requires to be heated externally for a few minutes, when it burns as you perceive with a large, lambent, feebly luminous flame. Neither are we in the habit of regarding the acetates as soaps, yet solutions of acetates possess the property of forming a persistent froth or lather to such an extent as to be highly characteristic; so that by searching out for latent resemblances we perceive that the different members of the series from the top to the bottom are associated with one another in a very intimate manner.

The primary aromatic acids at present known are far less numerous, and the series consequently far more limited, as shown in the table:—

Monatomic Aromatic Acid Series.

$C_6 H_4 O_2$	Collic.
$C_7 H_6 O_2$	Benzoic.
$C_8 H_{10} O_2$	Toluic.
$C_9 H_{12} O_2$	Picic.
$C_{10} H_{14} O_2$	Cuminic.

The first on the list is collic acid, a product of the artificial oxidation of albuminous matter. Next we have benzoic acid, which is usually regarded as the representative in this series of acetic acid in the fatty series. This is followed by two acids of which at present comparatively little is known, namely, the toluic and picic; while the series is terminated by cuminic acid, a product formed by the spontaneous oxidation of the chief constituent of oil of cumin. Now, just as the acetic and propionic acids are associated each with their respective hydrocarbons, alcohols, aldehydes, and more highly oxidised acids, as shown in the tables to which I have already adverted, so is every other primary monobasic acid, both of the fatty and aromatic series, associated with a more or less complete set of congeners, having to it the same relations of composition, properties, and mutual metamorphosis, that the various members of the acetic and propionic families have to the acetic and propionic acids respectively. Here, for example, are tabulated the principal compounds which are associated in this manner with benzoic acid:—

Benzoic Group.

C_7H_8	Benzoene.
C_7H_8O	Benzylic alcohol.
$C_7H_8O_2$	Benzylic glycol.
C_7H_6O	Benzoic aldehyd.
$C_7H_6O_2$	*Benzoic acid.*
$C_7H_6O_3$	Ampelic acid, &c.

Conversely we may select any set of compounds occupying analogous positions in the different groups and arrange them in series corresponding to those of the monobasic acids. Here, for instance, we have the series of aromatic hydrocarbons:—

Aromatic Hydrocarbon Series.

$C_6 H_6$	Phenene.
$C_7 H_8$	Benzoene.
$C_8 H_{10}$	Xylene.
$C_9 H_{12}$	Retinine.
$C_{10} H_{14}$	Cumene.

In the next table we have the series of primary fatty alcohols and aldehyds :—

Alcohol Series.		Aldehyd Series.	
$C\,H_4\,O$	Methylic.	$C\,Cl_2\,O$	Chloroformic.
$C_2H_6\,O$	Ethylic.	$C_2H_4\,O$	Acetic.
$C_3H_8\,O$	Propylic.	$C_3H_6\,O$	Propionic.
$C_4H_{10}O$	Butylic.	$C_4H_8\,O$	Butyric.
$C_5H_{12}O$	Amylic.	$C_5H_{10}O$	Valeric.
$C_6H_{14}O$	Hexylic.	$C_6H_{12}O$	Caproic.
$C_7H_{16}O$	Anthylic.	$C_7H_{14}O$	Œnanthic.
	&c.		&c.

Lastly, we have the carbonic and oxalic series of acids appertaining to the primary monobasic acids, and to the above tabulated alcohols and aldehyds :—

Diatomic Acid Series.

$C\;H_2\,O_3$	Carbonic.	,,	,,
$C_2\,H_4\,O_3$	Glycolic.	$C_2\,H_2\,O_4$	Oxalic.
$C_3\,H_6\,O_3$	Lactic.	$C_3\,H_4\,O_4$	Malonic.
$C_4\,H_8\,O_3$	Butilactic.	$C_4\,H_6\,O_4$	Succinic.
$C_5\,H_{10}O_3$	Phocic.	$C_5\,H_8\,O_4$	Pyrotartric.
$C_6\,H_{12}O_3$	Leucic.	$C_6\,H_{10}O_4$	Adiptic.
$C_7\,H_{14}O_3$	Wanting	$C_7\,H_{12}O_4$	Pimelic.
$C_8\,H_{16}O_3$		$C_8\,H_{14}O_4$	Suberic.
$C_9\,H_{18}O_3$		$C_9\,H_{16}O_4$	Anchoic.
$C_{10}H_{20}O_3$		$C_{10}H_{18}O_4$	Sebacic.

Accordingly, when we break up any complex animal product into its simpler constituent molecules, by an absorption of water, we are always, or nearly always, able to refer each of the completed molecules to its appropriate position in some homologous series and in some heterologous grouping; just as we accord to common alcohol its proper place both in the series of alcohols and in the group of acetic compounds.

Now, let us apply these several considerations to unravel the composition and relationship of some particular animal product, say hippuric acid, of which a very beautiful specimen, kindly lent me for the occasion by Messrs. Hopkins and Williams, is now on the table before you. Hippuric acid, the molecule of which is represented by the very complex formula $C_9H_9NO_3$, and is composed, therefore, of 22 constituent atoms, is now known to consist of a residue of benzoic acid, a residue of oxiacetic or glycolic acid, and a residue of ammonia united with one another in a particular manner.

α. Benzoic acid . . .	$C_7H_6O_2$
β. Oxiacetic acid . . .	$C_2H_4O_3$
γ. Ammonia. . . .	H_3N
	$C_9H_{13}NO_5$
— 2 Water	$H_4\quad O_2$
Hippuric acid . . .	$C_9H_9\,NO_3$

The positions of the benzoic and glycolic acid in the groups and series to which they belong have been already referred to—the benzoic being the second on the list of the primary aromatic acid series, the glycolic being second on the list of the carbonic acid series—the former being the pivot of the benzoic, the latter a member of the acetic group.

You observe that by subtracting two atoms of water from the sum of the atoms of carbon, hydrogen, nitrogen, and oxygen contained in the three molecules of benzoic acid, oxiacetic acid, and ammonia, there is left a compound having the formula of hippuric acid. Now there are few bodies about whose intimate constitution greater varieties of opinion have been maintained than with regard to hippuric acid. Each successive chemist who examined the body acted upon it with a different reagent, and accordingly as the special reagent employed attacked one or other of the different residues entering into the constitution of the acid, so was a different hypothetical formula accorded to the unfortunate compound. Of the three constituent residues, the acetic is the most easily oxidisable, and accordingly when hippuric acid is acted upon by oxidising agents, peroxide of lead, for instance, the acetic residue is destroyed, while the benzoic and ammonia residues remain combined with one another in the form of benzamide. Hence hippuric acid was represented as a compound of some form of acetic acid with benzamide, which is itself resolvable into benzoic acid and ammonia.

α. Benzoic acid. . . .	$C_7H_6O_2$
γ. Ammonia	H_3N
	$C_7H_9N\,O_2$
— Water	$H_2\quad O$
Benzamide	$C_7H_7N\,O$

Ammonia undergoes a very remarkable decomposition when acted upon by nitrous acid, its hydrogen being transformed into water and its nitrogen liberated in the gaseous state, thus :

$$H_3N + HNO_2 = 2H_2O + N_2.$$

Accordingly, when hippuric acid is treated with nitrous acid, the ammoniacal residue is similarly destroyed by the nitrous acid, while the two other residues are left combined with one another in the form of benzoglycolic acid. Hence, hippuric acid has been represented as a combination of ammonia with benzoglycolic acid, which is itself susceptible of decomposition into its constituent benzoic and glycolic acids—

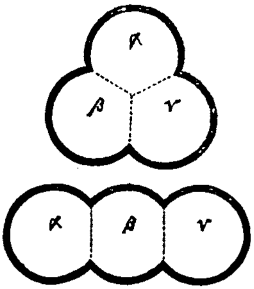
α Benzoic acid . .	$C_7H_6O_2$
β Glycolic acid . .	$C_2H_4O_3$
	$C_9H_{10}O_5$
— Water . . .	$H_2\,O$
Benzoglycolic acid .	$C_9H_8O_4$.

I am not aware of any reagents capable of destroying the benzoic residue, and so leaving the glycolic and ammoniacal residues in combination with one another; but on boiling hippuric acid with acids or alkalies, the benzoic may be separated from the other two residues which are thus obtained in the form of glycocine, or sugar of gelatine. Hence hippuric has been, and is now, commonly regarded as a compound of benzoic acid with glycocine, which is itself resolvable into glycolic acid and ammonia.

β Glycolic acid .	$C_2H_4O_3$
γ Ammonia . .	H_3N
	$C_2H_7NO_3$
— Water . . .	$H_2\quad O$
Glycocine . .	$C\,H_5NO_2$.

Our actual knowledge, then, of the constitution of hippuric acid amounts to this, that it contains the residues of three distinct molecules, which by an absorption of water are capable of being obtained separate from one another. When any one of these residues is destroyed or removed the other two residues are left in combination, and accordingly by treating hippuric acid with different reagents we may obtain the benzoic and ammoniacal residues in the form of benzamide, or the benzoic and glycolic residues in the form of benzoglycolic acid, or the glycolic and ammoniacal residues in the form of sugar of gelatine. To this much, which is certain, a something may be added which is probable. From many considerations into which I cannot at present enter, it seems, at any rate, that the ammoniacal constituent of hippuric acid is actually in more intimate association with the glycolic than with the benzoic residue, so that the composition of hippuric acid would be better represented by a chain of three circles than by a trefoil, as contrasted in the diagram below:

Populine.



Although, as I have said, the benzoic and ammoniacal residues may be left in combination with one another by the excision, so to speak, of the glycolic residue. Be this as it may, I shall assume that hippuric acid consists of a residue of benzoic acid and a residue of glycocine, which last consists of a residue of glycolic or acetic acid combined with a residue of ammonia; and similarly in the case of many other bodies composed of more than two ultimate residues, I shall assume, with greater or less warrant, that we can ascertain the mode in which the residues are successively appended to one another, as in the list of bodies which I am now about to bring under your notice.

The compounds whose names are written up in the first column of the following tables occur either as natural products of the animal body, or as constituent residues of such natural products. In the second and third columns are given the names of the simpler molecules, by the mutual combination of which, with elimination of water, the corresponding bodies named in the first column are produced. I think I may venture to say that in every instance the bodies in the first column have been proved to consist of the residues which they are here represented to contain, although, as I have said, in those bodies which are composed of more than two ultimate residues, the order in which the residues are successively combined, or the relation in which any two of them stand to the remainder, may be to some extent a matter of assumption. In these tables the word "acid" is omitted for the sake of space:—

Isethionic.	Alcohol.	Sulphurous.
Methylamine.	Wood spirit.	Ammonia.
Urea.	Carbonic.	Ammonia.
Glycocine.	Glycolic.	Ammonia.
Leucine.	Leucic.	Ammonia.
Spermaceti.	Palmitic.	Cetal.
Myricine.	Palmitic.	Melyssal.
Palmitine.	Palmitic.	Glycerine.
Stearine.	Stearic.	Glycerine.
Oleine.	Oleic.	Glycerine.

The first of these bodies, namely, isethionic acid, is a constituent of taurine, and is formed by the union of alcohol and sulphurous acid with elimination of water, or, in other words, it contains a residue of each of these two bodies. Next on the list is methylamine, a frequent product of the putrefactive decomposition of animal matter. It contains a residue of wood spirit and a residue of ammonia.

Then we come to urea, which contains a residue of carbonic acid and a residue of ammonia. In my first lecture I spoke of urea as being the ammoniated form of carbonic acid—as bearing to carbonic acid the same relation that ammonia bears to water—whereas I now represent it as a compound of carbonic acid and ammonia with elimination of water; but a little consideration will show that the two modes of regarding this and similar bodies are substantially the same. The empirical formula for carbonic acid—by which I mean hydrated carbonic acid—is CH_2O_3, while that for urea is CH_4N_2O. But regarding the two bodies as derivatives of the double atoms of water and ammonia respectively, or as the hydrate and amide of carbonyl, these formulæ become $(CO)''H_2O_2$, corresponding to H_4O_2, and $(CO)''H_4N_2$ corresponding to H_6N_2 respectively. Accordingly, the representation of urea as a compound of carbonic acid and ammonia with elimination of water, or as a variety of carbonic acid in which certain elements of water are replaced by the corresponding elements of ammonia, is shown in these almost identical equations:—

$$\overset{\text{Carbonic Acid.}}{CH_2O_3} + \overset{\text{2-Ammonia.}}{H_6N_2} - \overset{\text{2-Water.}}{H_4O_2} = \overset{\text{Urea.}}{CH_4N_2O}$$
$$(CO)H_2O_2 + (H_2)H_4N_2 = (H_2)H_2O_2 + (CO)H_4N_2.$$

Glycocine, or sugar of gelatine, the next compound on the list, contains, as I have already observed, a residue of ammonia and a residue of glycolic or oxiacetic acid. Leucine, a body upon which I shall offer some observations in a future lecture, is a homologue of glycocine, and contains a residue of ammonia and a residue of leucic acid. We now come to spermaceti, which contains a residue of palmitic acid, an important member of our primary series of fatty acids, united with the residue of a solid alcohol, the cetylic, which bears to palmitic acid precisely the same relation that common ethylic alcohol bears to acetic acid, so that spermaceti is a true homologue of acetic ether, as shown in these equations:—

$$\overset{\text{Acetic.}}{C_2H_4O_2} + \overset{\text{Ethylic.}}{C_2H_6O} - H_2O = \overset{\text{Acetic Ether.}}{C_4H_8O_2}.$$
$$\overset{\text{Palmitic.}}{C_{15}H_{30}O_2} + \overset{\text{Cetylic.}}{C_{15}H_{32}O} - H_2O = \overset{\text{Spermaceti.}}{C_{30}H_{60}O_2}.$$

Next, we have myricine, which forms from 60 to 80 per cent. of ordinary beeswax, and is composed of a residue of palmitic acid united with a residue of another solid alcohol, the melyssic, having the formula $C_{30}H_{62}O$.

The three following bodies are selected as examples of the true fats. The first of them, namely, palmitine, is an important constituent of palm oil or butter, and also exists in human and other soft fats to a considerable extent. Palmitine, stearine, and oleine are produced in accordance with the same typical equation, $3A + B - 3H_2O = X$, as shown below:—

$$\overset{\text{Fatty acid.}}{3C_{15}H_{30}O_2} + \overset{\text{Glycerine.}}{C_3H_8O_3} - 3H_2O = \text{palmitine.}$$
$$3C_{17}H_{34}O_2 + C_3H_8O_3 - 3H_2O = \text{stearine.}$$
$$3C_{17}H_{32}O_2 + C_3H_8O_3 - 3H_2O = \text{oleine.}$$

You observe that stearic acid is a homologue of palmitic acid, to which it stands next but one on the series; but oleic acid, which differs in composition from stearic acid by a deficiency of two hydrogen atoms, belongs to another set of compounds altogether, namely, the secondary series of fatty acids. The first known member of this series is the acrolic acid, which is a member of the propionic group, and which, as you may perceive by referring to the previous table of propionic compounds, bears to propionic acid the same relation that oleic acid bears to stearic acid.

All the bodies in the table we have just considered contain the residues of what may be regarded as primary molecules; but one or other of the residues contained in the several compounds included in the next table is itself a complex body built up by the union of two or more simple molecules.

Taurine.	Isethionic.	Ammonia.
Sarcosine.	Methylamine.	Glycolic.
Allophan.	Urea.	Carbonic.
Paraban.	Urea.	Oxalic.
Alloxan.	Urea.	Mesoxalic.
Hippuric.	Glycocine.	Benzoic.
Bile acid α.	Glycocine.	Cholic.
Bile acid β.	Taurine.	Cholic.

Thus, taurine, of which I am able, through the kindness of Mr. Lloyd Bullock, to exhibit a very beautiful specimen, contains a residue of ammonia united with a residue of isethionic acid, which already contains a residue of alcohol and a residue of sulphurous acid. Sarcosine, which is a constituent of kreatine, contains a residue of glycolic acid and a residue of methylamine, which itself contains a residue of wood spirit and a residue of ammonia. Allophan is a purely artificial product, closely related to paraban and alloxan, which are products of the oxidation of uric acid. These three bodies contain respectively a residue of carbonic acid CH_2O_3, of oxalic acid $C_2H_2O_4$, and of mesoxalic acid $C_3H_2O_5$, combined with a residue of urea, which itself contains a residue of carbonic acid and a residue of ammonia. The constitution of all three bodies is expressed by the same typical equation $A + B - 2H_2O = X$, as exemplified below in the case of alloxan.

$$\overset{\text{Mesoxalic.}}{C_3H_2O_5} + \overset{\text{Urea.}}{CH_4N_2O} - 2H_2O = \overset{\text{Alloxan.}}{C_4H_2N_2O_4}.$$

We next come to hippuric acid, which, as we have already seen, contains a residue of benzoic acid and a residue of glycocine, which itself contains residues of glycolic acid and ammonia. This is succeeded by the two principal acids of the bile, the first of which, or glycocholic acid, contains a residue of cholic acid, and a residue of glycocine, and consequently differs from hippuric acid in containing a residue of cholic acid $C_{24}H_{40}O_5$, instead of a residue of benzoic acid $C_7H_6O_2$. The other bile acid known as tauro-cholic acid contains a residue of cholic acid and a residue of taurine, which already contains residues of ammonia and isethionic acid, the latter body further containing a residue of alcohol and a residue of sulphurous acid, thus:—

$$\text{Tauro-cholic}\left\{\begin{array}{l}\text{Cholic acid}\\ \text{Taurine}\left\{\begin{array}{l}\text{Ammonia}\\ \text{Isethionic}\left\{\begin{array}{l}\text{Alcohol.}\\ \text{Sulphurous.}\end{array}\right.\end{array}\right.\end{array}\right.$$

The last compound which I propose to bring under your notice to-day is kreatine, a beautiful crystalline body, as you may perceive, from the unusually fine specimen lent me by Dr. Hugo Müller. This body, which exists largely in the juice of flesh, and also, though to much less amount, in human urine, is represented by the formula $C_4H_9N_3O_2$. Under the influence of caustic baryta it absorbs water with transformation into sarcosine and urea, the residues of which pre-exist in the kreatine, thus,—

$$\overset{\text{Sarcocine.}}{C_3H_7NO_2} + \overset{\text{Urea.}}{CH_4N_2O} - H_2O = \overset{\text{Kreatin.}}{C_4H_9N_3O_2}.$$

As we have already observed, the urea contains residues of carbonic acid and ammonia, and the sarcosine residues of glycolic acid and methylamine, which last body further contains a residue of ammonia and a residue of wood spirit, as shown in this diagram—

$$\text{Kreatine}\left\{\begin{array}{l}\text{Urea}\left\{\begin{array}{l}\text{Carbonic}\\ \text{Ammonia}\end{array}\right.\\ \\ \text{Sarcosine}\left\{\begin{array}{l}\text{Glycolic}\\ \text{Methylamine}\left\{\begin{array}{l}\text{Wood spirit.}\\ \text{Ammonia.}\end{array}\right.\end{array}\right.\end{array}\right.$$

Concluding with these extremely complex animal products, I trust I have satisfied you of the main position with which we started, that highly complex molecules are built up of the residues of less complex molecules, which less complex molecules are capable for the most part of being referred to definite positions in certain natural series or groups of associated bodies,—in such series as those of the aromatic and fatty acids, aldehydes, alcohols, &c., and in such groups as the benzoic, acetic, propionic, and butyric, for instance.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, June 9.

"*On Researches in Organic Chemistry in the Royal Institution.*" By **Edward Frankland**, Esq., F.R.S., Professor of Chemistry, R.I.

The vast crowd of organic compounds with which modern research has made us acquainted have been grouped into a comparatively small number of families, each containing substances closely allied in chemical character. Thus, amongst others, the following families or series of organic bodies are well known and sharply defined:—

1. The Marsh-gas Family.
2. The Alcohols.
3. The Organic Ammonias.
4. The Fatty, or Acetic Series of Acids.
5. The Organic Oxalic Acids, or Lactic Series.
6. The Acrylic Series of Acids.

The speaker referred especially to the last three families as having been the subjects of the researches carried on in the laboratory of the Royal Institution during the past year by his friend Mr. Duppa and himself. Two of these families had already received the careful study of many chemists; the acetic having been especially illustrated by the classic researches of Kolbe and Gerhardt, whilst the lactic family had quite recently had the advantage of the equally remarkable investigations of Wurtz and Kolbe. Nevertheless, there seemed to be still some points of great interest regarding the arrangement of the atoms of these acids,—their atomic architecture, so to speak,—which had not yet received elucidation; whilst the acrylic family had hitherto enjoyed comparatively but little attention from chemists.

It had been proved by Kolbe and the speaker, nearly twenty years ago, that methyl (CH_3) is a constituent of acetic acid, and more recently that acetic acid and acetic ether are constructed upon the carbonic acid or tetratomic carbon type, the formula of acetic ether being—

$$C\left\{\begin{array}{l}C\left\{\begin{array}{l}H\\ H\\ H\end{array}\right.\\ O\\ O\,(C_2H_5)\end{array}\right.$$

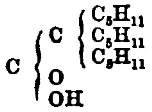
From this formula it was seen that the radical methyl in acetic ether contained three single atoms of hydrogen combined with a tetratomic atom of carbon; and the speaker and his friend proposed to themselves the question: Can this hydrogen be replaced atom for atom by the alcohol radicals methyl, ethyl, &c.? In endeavouring to solve this problem, they availed themselves of that class of chemical reactions in which an electro-positive atom is expelled from a compound by a more electro-positive atom. Acetic ether was submitted to the action of sodium, by which two compounds of the following composition were obtained:

$$\left\{\begin{array}{l}C\left\{\begin{array}{l}Na\\ H\\ H\end{array}\right.\\ O\\ OC_2H_5\end{array}\right. \quad \text{and} \quad C\left\{\begin{array}{l}C\left\{\begin{array}{l}Na\\ Na\\ H\end{array}\right.\\ O\\ OC_2H_5\end{array}\right.$$

These compounds, when brought into contact with the iodides of methyl, ethyl, &c., yielded ethers, exhibiting the substitution which it was sought to obtain. In this way there had been produced the following ethers:—

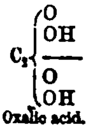
$$\underset{\text{Ethacetic or butyric ether.}}{C\left\{\begin{array}{l}C\left\{\begin{array}{l}C_2H_5\\ H\\ H\end{array}\right.\\ O\\ OC_2H_5\end{array}\right.} \quad \underset{\text{Dimethacetic ether.}}{C\left\{\begin{array}{l}C\left\{\begin{array}{l}CH_3\\ CH_3\\ H\end{array}\right.\\ O\\ OC_2H_5\end{array}\right.} \quad \underset{\text{Diethacetic ether.}}{C\left\{\begin{array}{l}C\left\{\begin{array}{l}C_2H_5\\ C_2H_5\\ H\end{array}\right.\\ O\\ OC_2H_5\end{array}\right.} \quad \underset{\text{Œnanthylic ether.}}{C\left\{\begin{array}{l}C\left\{\begin{array}{l}C_5H_{11}\\ H\\ H\end{array}\right.\\ O\\ OC_2H_5\end{array}\right.}$$

These ethers readily yielded their respective acids by contact with alcoholic solution of potash, and thus the homologous series of fatty acids could be ascended step by step, starting from acetic acid, and terminating with an acid of the composition of margaric acid, containing three atoms of amyl in the place of the three atoms of hydrogen in the methyl of acetic ether.



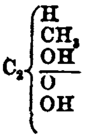
$$C\left\{\begin{array}{l}C\left\{\begin{array}{l}C_5H_{11}\\C_5H_{11}\\C_5H_{11}\end{array}\right.\\O\\OH\end{array}\right.$$

A similar inquiry had been instituted with regard to the family of acids of which lactic acid is a member, and it had been proved that this series of acids are derived from oxalic acid by the substitution of one atom of diatomic oxygen, in the latter by two of hydrogen, methyl, ethyl, &c. The following, amongst numerous other examples, were referred to in illustration of the relations of the primary to the derived acids :—



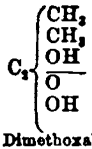
$$C_2\left\{\begin{array}{l}O\\OH\\\hline O\\OH\end{array}\right.$$

Oxalic acid.



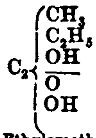
$$C_2\left\{\begin{array}{l}H\\CH_3\\OH\\\hline O\\OH\end{array}\right.$$

Lactic acid.



$$C_2\left\{\begin{array}{l}CH_3\\CH_3\\OH\\\hline O\\OH\end{array}\right.$$

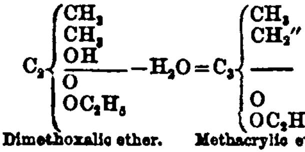
Dimethoxalic acid.



$$C_2\left\{\begin{array}{l}CH_3\\C_2H_5\\OH\\\hline O\\OH\end{array}\right.$$

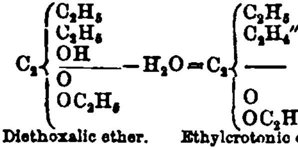
Ethylomethoxalic acid.

From the lactic family of acids access had also been gained to the acrylic family, for it had been found that the abstraction of water from the ether of an acid of the lactic family converted it into the ether of an acid of the acrylic family, thus :—



$$C_2\left\{\begin{array}{l}CH_3\\CH_3\\OH\\\hline O\\OC_2H_5\end{array}\right. -H_2O=C_2\left\{\begin{array}{l}CH_3\\CH_2''\\\hline O\\OC_2H_5\end{array}\right.$$

Dimethoxalic ether. Methacrylic ether.



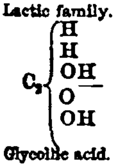
$$C_2\left\{\begin{array}{l}C_2H_5\\C_2H_5\\OH\\\hline O\\OC_2H_5\end{array}\right. -H_2O=C_2\left\{\begin{array}{l}C_2H_5\\C_2H_4''\\\hline O\\OC_2H_5\end{array}\right.$$

Diethoxalic ether. Ethylcrotonic ether.

The production of these acids was not merely interesting on account of the addition of new members to the acrylic family, but their derivation from the synthesized acids of the lactic family afforded the most convincing proof of the style of architecture in which they were built up.

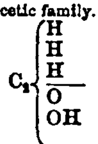
The investigation of the three families of acids had conclusively established between them the very simple relations exhibited in the three following formulæ :—

Lactic family. Acetic family. Acrylic family.



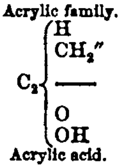
$$C_2\left\{\begin{array}{l}H\\H\\OH\\\hline O\\OH\end{array}\right.$$

Glycollic acid.



$$C_2\left\{\begin{array}{l}H\\H\\H\\\hline O\\OH\end{array}\right.$$

Acetic acid.



$$C_2\left\{\begin{array}{l}H\\CH_2''\\\hline O\\OH\end{array}\right.$$

Acrylic acid.

The speaker concluded as follows :—The day has almost gone by when the experimenter was asked the use of such investigations as these; nevertheless, it may fairly be demanded, Whither do such researches tend? What is their object? The sole object that we have had in view in these investigations has been the discovery of the laws according to which organic compounds are moulded—those compounds, the transformation of which from one state of combination to another constitutes an essential part of the phenomena we call life. There is no royal road to this kind of knowledge. It is only by thus patiently and laboriously examining every part of the subject that the combined efforts of the physicist, the physiologist, and the chemist will one day be able to solve the organic problems which at the present moment appear so unapproachable. The work before us requires a vast amount of experiment and thought. Would that more labourers were engaged in it! How many men of leisure and ability are almost compelled to pass through life with no higher object than their own amusement? Why cannot our schools and universities furnish the next generation of such men with the scientific knowledge necessary to enable them to take part in the glorious work of investigating Nature?

ACADEMY OF SCIENCES.

July 31.

M. E. **Frémy** made a second communication, entitled "*Chemical Researches on the Green Matter in Leaves.*" By a reference to our pages we find that it is five years since M. Frémy made his former communication (see Chemical News, vol. I., p. 228), in which he announced his discovery that the green matter of leaves was composed of a blue and a yellow matter, to which he gave the names *phyllocyanine* and *phylloxanthine*. He then separated these two bodies by shaking chlorophyll, extracted from leaves by alcohol, with a mixture of dilute hydrochloric acid and ether. Under the influence of the acid, the chlorophyll split up, the yellow matter dissolved in the ether, and the acid became of a blue colour. M. Frémy since this time has occupied himself in discovering less energetic solvents, to satisfy himself that these two bodies really existed in the plant, and were not produced by the chemical action of the hydrochloric acid on the chlorophyll. The author has now found that the earthy bases, especially alumina, added to an alcoholic solution of chlorophyll, combine with the green matter, which is precipitated as a lake, leaving the yellow matter in solution. With the alkaline earths, and particularly baryta, the reaction is more distinct. When an alcoholic solution of chlorophyll is boiled with hydrate of baryta, it is split up, and the phylloxanthine, which is a neutral body insoluble in water, is precipitated along with a baryta salt of *phyllocyanic acid*. Thus chlorophyll is seen to be a sort of coloured fat, which undergoes saponification by the action of powerful bases, and in which the phylloxanthine appears to be the glycerine and the bluish-green phyllocyanic acid the fatty acid. Alcohol dissolves the former body from the mixed precipitate, and the solution on evaporation yields crystals sometimes yellow plates and sometimes reddish prisms, the colour of which reminds us of bichromate of potash. These crystals are insoluble in water, but soluble in alcohol and ether; they possess considerable tinctorial power. The baryta salt of phyllocyanic acid may be decomposed by sulphuric acid, and a solution is obtained which, according to the strength, may be green, reddish, violet, or a beautiful blue. M. Frémy does not think that the two bodies exist together in chlorophyll; he believes this body to be an immediate green principle of excessive changeability, which, under the influence of reagents, and probably by the action of vegetation, undergoes various modifications, and produces the bodies described above. We shall probably return to this paper.

M. Fouqué sent an analysis of the gases now escaping from the fumaroles on Mount Etna. The following is the mean of some containing the maximum of carbonic acid :—

Sulphydric acid	0·45
Carbonic acid	5·00
Oxygen	17·27
Nitrogen	77·28
	100·00

In some of the fumaroles the carbonic acid did not exceed 1 per cent.

M. Hiortdahl presented a note "*On the Action of Zircon on Alkaline Carbonates and Chlorides.*" Silico-zirconates are common in nature, and the author tried to produce them artificially; but he found that when silica, zirconia, and an alkali are heated together only the zirconia enters into combination with the alkali. By employing zirconia or a corresponding mixture of zirconia and silica, he has thus been able to prepare crystallised zirconates. When zircon is fused with an excess of carbonate of soda, and the fused mass is treated with dilute hydrochloric acid, a crystalline powder deposits, the analysis of which shows it to be the compound $NaO8ZrO_2 + 12HO$. Zircon, or a mixture of zirconia and silica, fused with chloride of calcium or magnesium, produces crystallised zirconates exempt from silica. This, and the paper by the same author we noticed last, are important contributions to our knowledge of the rare element zirconium, and we shall reproduce them in longer abstract.

M. Naquet presented a note "*On Thymotide*," the body produced by the action of perchloride of phosphorus on thymotic acid, resulting in the removal from the latter body of the elements of water. It is also produced by the action of anhydrous phosphoric acid on thymotic acid. The author regards thymotic as the homologue of salicylide, and remarks that these two bodies are to thymotic and salicylic acid what coumarine is to coumaric acid, and perhaps camphor to camphoric acid.

MM. Millon and Commaille made a communication "*On the Affinity of Caseine for Bases.*" By rubbing caseine and magnesia together with a little water, the authors obtained a liquid which, filtered into alcohol, gave a flocculent precipitate of a compound of one equivalent of caseine, two equivalents of magnesia, and four equivalents of water. They further discovered that caseine will unite with two oxides at the same time, and they formed various cupro-magnesic, cupro-calcic, and cupro-barytic, sodic, and ammonaical compounds with caseine. Combinations of oxide of zinc, potash, and caseine, mercuric oxide, ammonia, and caseine, and lastly a silver compound. This last compound possesses the most interest. It is formed when a perfectly neutral solution of nitrate of silver is poured into an ammoniacal solution of caseine, and is precipitated as a cheesy mass, which must be washed with water, alcohol, and ether. When dried in the dark it is white, but turns yellow in diffuse light, and blackens in the sun. It is insoluble in water, but very soluble in caustic ammonia. The authors say that this compound deserves the attention of photographers.

NOTICES OF BOOKS.

Annalen de Chimie et de Physique, June, 1865.

The first article in this number is by M. A. Geradin—"*Researches on the Solubility of Salts in Mixtures of Alcohol and Water.*" It opens with an introduction giving a review of the various theories advanced on the subject of solution from Newton and Gassendi to Mulder and Graham. It may be useful to young readers to reproduce this introduction, which, however, we must defer for the present. With regard to the solubility of salts in mixtures of alcohol and water, the author has arrived at the following conclusions :—1. All salts insoluble in alcohol and soluble in water have, in mixtures of alcohol and water at a constant temperature, a solubility decreasing as the proportion of water in the mixture is diminished. 2. The solubility of these salts is not proportional to the amount of water contained in the mixture. The quantity dissolved is always less than would dissolve in the same amount of water by itself.

The next paper, by M. Nicklés, "*On the Existence of Perchloride of Manganese,*" we have noticed already in our reports of the Academy of Sciences (C. N., vol. xi., p. 129). Some further details are given here respecting the formation of perbromides and periodides of manganese, of the existence of which the author leaves no doubt. These compounds are very peculiar (*singulier*). They are not acids, for contact with bases destroys them ; they are not alkaline, for they combine with ether as chlorides do; they are not neutral, for acids give them stability. In all respects they deserve to be called *peculiar*, as M. Dumas called them by anticipation forty years ago.

A short description of "*A New Air-pump with a Free Piston,*" by M. Deleuil, would not be intelligible without the accompanying woodcuts. The instrument appears to offer many advantages. The piston being free from the walls of the cylinder, there is no friction and no resistance; and no oil being required, the machine is always in order. It is a cheap machine, also.

The remainder of the journal is occupied with a part of a memoir, by MM. Berthelot and de Fleurieu, "*On the Estimation of Tartaric Acid, Potash, and Bitartrates of Potash in Vinous Liquors.*" An abstract of this paper, from the *Comptes-Rendus*, appeared in the Chemical News for October 10, 1863 (vol. viii., p. 173), to which number we must refer our readers.

Annalen der Chemie und Pharmacie. July, 1865.

This journal opens with a paper by Dr. A. Ladenberg, "*On a New Method of Organic Analysis.*" We shall give an abstract of this paper very shortly, since the method is original, and may be useful in some cases. Erlenmeyer gives a preliminary notice of "*Distyrol, a New Polymer of Styrol,*" formed by heating together cinnamic and aqueous hydrobromic acids for several hours in a sealed tube. A heavy oily body is produced, which forms with bromine a crystalline bromide, of the composition $\Theta_{16}H_{16}Br_2$; hence the author concludes that the oil itself is distyrol, $\Theta_{16}H_{16}$. All the other papers of interest have been noticed.

Journal de Pharmacie et de Chimie. July, 1865.

MM. Bussy and Buignet communicate a paper "*On the Action of Tartaric Acid on Neutral Sulphate of Potash.*" From their experiments it appears that when an equivalent of sulphate of potash and an equivalent of tartaric acid are dissolved in water and the solution evaporated, the alkali becomes equally divided between the two acids. None of the other papers call for notice.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

653. P. Carlevaris, Genoa, "Producing a light applicable to photographic purposes, to lighthouses, and to other illuminations."—Petition recorded June 20, 1865.

1790. A. V. Newton, Chancery Lane, "Certain improvements in the manufacture of superphosphate of lime from guano." A communication from G. A. Liebig, Baltimore, Ma., U.S.A.—July 6, 1865.

1857. R. V. Tuson, St. Paul's Road, Camden Town, "Improvements in the preparation and preservation of foods for animals."—July 15, 1865.

Notices to Proceed.

765. J. C. Stevenson, South Shields, "Improvements in the preparation of hyposulphite of lime."—Petition recorded March 18, 1865.

777. R. T. Crawshay and J. A. Lewis, Cyfarthfa Iron Works, Glamorganshire, "Improvements in the manufacture of puddled iron bars and every description of malleable iron."—March 20, 1865.

864. F. Le Roy, Saint Saulve, France, "Certain improvements in non-conducting composition for preventing the radiation or transmission of heat or cold."—March 27, 1865.

891. J. Player, Norton, Stockton-upon-Tees, "Improvements in furnaces or apparatus for heating the blast for furnaces used in smelting iron, and for other furnaces."—March 29, 1865.

899. W. Brookes, Chancery Lane, "A new or improved mode of rapidly reducing, cementing, and melting iron and other ores, also iron slag or cinders, drops, and scales or crust, to produce directly therefrom steel, or malleable, or cast iron." A communication from J. B. Helson, Hautmont, France.

900. A. A. Croll, Coleman Street, "Improvements in the manufacture of sulphate of alumina."—March 30, 1865.

980. G. Davies, Serle Street, Lincoln's Inn, "Improvements in the means of, and apparatus for, increasing the illuminating power of hydrocarbon oils and gases."—A communication from T. S. Speakman, Camden, New Jersey, U.S.A.—April 6, 1865.

1008. G. Davies, Serle Street, Lincoln's Inn, "An improved composition for preventing the fouling of ships and other vessels."—A communication from W. B. Davis, Brooklyn, Kingscounty, N.Y., U.S.A.—April 8, 1865.

1076. J. Dougan, Coed Talon, near Mold, North Wales, "Improvements in apparatus for distilling hydrocarbons from coal schists and other minerals."—April 17, 1865.

1159. J. C. Wickham, Elizabeth Cottage, Bow, and A. E. Deiss, Bow Bridge, "Improvements in the manufacture of waterproof fabrics, and in apparatus to be employed therein."—April 25, 1865.

1679. J. Gale, Devonshire Terrace, Plymouth, "Improvements in preparing and treating gunpowder."—June 22, 1865.

1690. M. A. Muir and J. McIlwham, Glasgow, N.B., "Improved sanitary apparatus or arrangements for preventing noxious exhalations, such as arise when coating or treating iron or other articles."—June 24, 1865.

1885. G. Nimmo, Jersey, New Jersey, U.S.A., "An improvement in the mode of uniting different metals, such as iron and copper, or alloys, to form compound and metallic castings."—July 19, 1865.

CORRESPONDENCE.

Continental Science.

PARIS, August 7.

OUR new "*Codex*," which has not been quite so long in preparation as the British Pharmacopœia was, is now completed, and will soon be published. It has been compiled by a special commission, appointed in June, 1861, and composed of professors in schools of medicine and pharmacy, which included most of our authorities on materia medica and pharmacy. The book has, therefore, been only four years in preparation. The last Codex was published in 1837, and it certainly needed revision. The editors are under no fear of meeting with such criticism as befel the unlucky compilers of the British Pharmacopœia. The Codex is published by authority, and must not be brought into contempt. Let it be noted also that the authority put up the printing and publishing to competition, and accepted the lowest tender, that of MM. Baillière and Sons.

I see in *Les Mondes* a notice of the completion of another long-expected book by Professor Goeppert, "*On the Organic Nature of the Diamond.*" The learned Professor contends that diamonds cannot have been produced by Plutonic action, since they become black when exposed to a very high temperature. He considers their Neptunian origin proved by the fact they have often on the surface impressions of grains of sand, and sometimes of crystals, showing that they have once been soft. Moreover, they are sometimes found to enclose other crystals, germs of fungi, and even vegetable structure of a higher origin. These facts would lead to the belief that diamonds are really the final product of the decomposition of vegetable substances. If so, some people may regret that you are using up your coal-fields so fast, since, if sufficient time were allowed, the black diamonds might change to white and real jewels.

I may mention here that the Abbé Moigno has commenced to publish the monthly review of scientific progress which he delivers at the rooms of the Société d'Encouragement. Any one who does not read *Les Mondes* (and, I may add, the CHEMICAL NEWS) would do well to subscribe for the work, which is published exceedingly cheap, and will be issued immediately after each conference. The reader will gain a good idea of what is done in France month by month in the practical applications of science in the industrial arts, although, if continued as this first number, they will gain no notion of the charming vivacity of the learned and *spirituel* abbé.

I do not remember to have mentioned that M. Wurtz has been selected by the Academy for the biennial prize of the Institute. A botanist, an engineer, and a chemist were presented by the several sections, but the ballot was eventually in favour of M. Wurtz, who gained 28 votes, the botanist, M. Thüret, gaining 22. M. Dupuy de Lôme, the engineer, was nowhere. No one, I imagine, will contest M. Wurtz's claims to the honour and the money, but he has already been fortunate enough to obtain the Jecker prize twice, once in 1860, and again this year, as you made known in the CHEMICAL NEWS.

I ought also to have mentioned the sudden decease of M. O. Reveil, one of our most industrious writers on pharmacy and toxicology, whose *Annuaire Pharmaceutique* for last year has just appeared. Without being brilliant, he was a painstaking, careful experimenter, and a lucid writer, who has done good service, and is much regretted by his friends and colleagues at the School of Pharmacy.

I told you last year that a Berlin doctor attributed the presence of cholera in Europe to the misgovernment of India by the English. The Berlin doctor, perhaps, is not alone in the opinion, for M. Bonnafont, a doctor at Arras, has just published a pamphlet in which he suggests some rather extensive drainage works to the Indian Government. His pamphlet is entitled,—"A Memoir on the Necessity for Rendering Healthy Marshy Countries in general, but especially those watered by the Delta of the Ganges, as the only Effectual Means of Preventing Invasions of Cholera." Sir Charles Wood, perhaps, will have time to read M. Bonnafont's pamphlet before Parliament meets.

MISCELLANEOUS.

Duty on Patent Medicines.—It is shown by an official document that in the year ending March 31 last the duty on patent medicines produced as much as 55,333*l.* 0s. 4½d.

Suspected Poisoning.—A young woman who seems to have been under medical treatment for some time was admitted to St. George's Hospital on the 19th July with all the symptoms of arsenical or antimonial poisoning, and she died the next day. Dr. Barclay made a post-mortem examination of the body, and found no natural cause for the symptoms under which the deceased had laboured; the stomach was in a state of extraordinary congestion, and he was led to the conclusion that the girl had died from poison—either antimony or arsenic. The Secretary of State was communicated with, and he ordered that the services of Dr. Swayne Taylor should be called in for a scientific analysis to be made of the viscera of the deceased. At the inquest Dr. Alfred S. Taylor, Professor of Medical Jurisprudence at Guy's Hospital, said he received a jar containing the stomach, &c., of the deceased on last Friday. The stomach had been opened. He examined the parts soon after. The stomach and intestines were very much putrefied, and he could not form any opinion of their state at the time of death. He analysed them to ascertain if there was any arsenic or antimony present in them. The result showed that there was no trace of either. He therefore concluded that the deceased had not taken any dose of either of these poisons for at least three weeks before her death. In his opinion, therefore, her death could not have arisen from poison. The symptoms mentioned by Dr. Barclay were just such as antimony or arsenic would cause; but the result of the analysis showed that those poisons were not administered. Death could only be attributed to those poisons when traces of them were found. Dr. Barclay said that, after hearing the result of the analysis, he could only attribute the deceased's death to natural causes. Dr. Taylor, in answer to the coroner, said that Professor Rudersdorf, of Holland, took part in the analysis, and he was of the same opinion as witness—that no arsenic or antimony could have been taken by her for weeks before her death, and therefore they could not have caused death. The coroner having summed up, the jury returned a verdict of "Death from natural causes."

The Case of Reputed Poisoning by Atropine.—The trial of Mr. Sprague took place at Exeter on the first of this month. We give only Mr. Herapath's evidence. He said: I am a professor of chemistry, residing at Bristol. On the 19th July I received a wooden box, corded and sealed. The seals were intact. In the box was a pie-dish, which I produce, with its contents. There is in it the fore leg of a rabbit and a small piece of beef. The meat when I received it was not putrid. When meat is cooked it decomposes in a different way. While the albumen is in a soluble state you get sulphuretted hydrogen and ammonia liberated; when the albumen becomes solid by cooking, the meat dries like a mummy and becomes covered with mould, which is not poisonous. In the box was also a jar with vomit and a parcel of flour. I first wrote for the symptoms to give me some clue as to the mode I should pursue; but before I had the answer I received a letter stating that it was right I should know that a mustard emetic had been given to one party, and sulphate of zinc and ipecacuanha to the others. Before I received that I had intended to begin with the vomit. I received letters from Dr. Gervis and Mr. Caunter, clerk to the magistrates, dated July 18, in which the former said he believed the parties had suffered from some vegetable narcotic poison, such as atropine or morphine. Witness then stated in great detail the course he pursued in his analysis of the matter which he had obtained by introducing the leg of the rabbit into dilute hydrochloric acid, and allowing it to soak therein, in order that any narcotic poison in the rabbit might be dissolved out. The tests he had used, he said, he had applied also to a solution of atropine which he himself made, and with precisely similar results. Mr. Herapath continued—I have no doubt whatever that there was atropine in the contents of the pie. I have also examined the vomit, and though the indications were not so good, I have no moral doubt there was atropine there. There was none in the flour; but I obtained some from the scrapings of the surface of the leg of the rabbit. If a rabbit had died from taking atropine I should not expect to find the poison in the surface of the leg, but in the liver and stomach. In the present case I should expect to find it in the brain and the sheath of the spinal marrow. Cross-examined: If the rabbit had eaten of belladonna I should have expected to find the poison in the liver and the brain. I have found both metallic and vegetable poisons in the livers of animals. All parts of the belladonna plant, I believe, are poisonous. I have heard of dogs eating grass, but never belladonna. I have never heard of any animals but goats eating hemlock, and I do not know what the effect on them is. I received the matters on the Wednesday, but I did not find the atropine until the Sunday; I had twenty or thirty experiments to go through. I had to satisfy myself that I was right, and the first thing to do was to separate all foreign matters from the poison. The first object of a toxicologist is to eliminate the poison. I had first of all to find what substances were with the poison, and then to take the proper solvents to remove those matters. I wrote to be supplied with the symptoms—as I always do—immediately I received the box. If I had not had the symptoms I should have had a great deal more difficulty in finding the poison. Perhaps I should not have found it at all. The poisons are divided into several classes, and the symptoms would show me which of these classes I should test for. It would be useless for me, as there are at least 200 poisons, to commence a series of experiments which might exhaust the material long before I had finished the tests. In the interval between the Wednesday and the Sunday my tests gave me indications of one of the three cerebro-spinal poisons—atropine, daturia, and aconitina—but the matter was not sufficiently clear of foreign mixture to be quite certain. Atropine and daturia, though prepared from different plants, are the same poison. I believe atropine has never been eliminated from an animal substance before. It has never been communicated before to the scientific world, but it is now through my evidence, and I shall be put on my trial quite as much as the prisoner. The poison, I think, must have been put in the pie while making, or on something that was put in the pie. I cannot say whether it was put in before or after the pie was cooking. The crust might have been lifted while it was hot, and the atropine put in; but my idea is that it was put in before the pie was cooked, and dissolved in the cooking.

The cross-examination of Professor Herapath was protracted to a great length, but without eliciting anything more of a material character, or shaking the learned gentleman's positive testimony that there was atropine in the pie. The prisoner was acquitted. In reference to this case Dr. Ogle has written to the *Times* mentioning some experiments of Runge, who found that rabbits could feed on belladonna leaves without being poisoned.

To Prevent Oaken Barrels from Colouring Spirit.—Dissolve one part of ammonia alum and two parts of sulphate of iron in 100 parts. Well wash the casks with this solution boiling hot, and allow them to stand for 24 hours. Then rinse out the casks well, dry them, and finally give them a washing with a thin solution of silicate of soda.—*Chem. Cent. Blatt.*, No. 25, p. 400.

Mercurialised Collodion.—The following application is recommended for venereal warts:—Bichloride of mercury, 25 centigrammes; collodion, 52 grammes. The bichloride, in fine powder, is shaken up with the collodion, and the mixture is applied with a camel's hair brush. One or two applications will effect a complete cure.

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. Private letters for the Editor must be so marked.

Vol. XI. of the Chemical News, containing a copious Index, is now ready, price 11s. 0d., by post, 11s. 6d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. XII. commenced on July 7, 1865, and will be complete in 26 numbers.

W. J. Grey.—A table for making the calculations is given in Mr. Greville Williams' "Chemical Manipulations."

T. C. (Bury).—Sulphate of lime is generally obtained in that form from acid solutions.

J. H.—Common salt is often used for the purpose, and, we believe, answers.

Received.—Mr. Newland, F.C.S.,—shall appear next week; D.; R.W.P.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Experiments on the Precipitation of Phosphoric Acid as Phosphomolybdate of Ammonia, by Dr. R. Fresenius.*

The author has studied the influence of various reagents on the estimation of phosphoric acid by precipitation as phosphomolybdate of ammonia, and has come to the following conclusions:—His experiments were made with the same solution of phosphate of soda, 10 c.c. of which precipitated and weighed as pyrophosphate of magnesia gave as a mean 0·0209 of phosphoric acid. The determinations with the molybdenic solution were controlled by a re-determination of the phosphoric acid in the precipitate as pyrophosphate of magnesia.

Ten c.c. of the phosphate of soda solution precipitated by the molybdenic solution gave 0·0206 phosphoric acid, or 99 per cent. of the amount really present.

Nitric acid, even when in very large excess, the author found not to interfere with the result.

Hydrochloric acid, when in large excess, partially or even completely hinders the precipitation. When the amount of the acid is as low as 3·3 per cent. of the liquid, the result comes near the truth, but is always too low.

The simultaneous presence of much nitric and hydrochloric acid completely prevents the precipitation.

Sulphuric acid, perchloride of iron, and chloride of aluminium, have but little influence on the amount of precipitate. Thus the 10 c.c. of phosphate of soda solution, as above, gave, in the presence of sulphuric acid, 0·0208 of phosphoric acid, and in a second experiment 0·0205. With perchloride of iron the same amount of phosphate of soda solution gave 0·0207 phosphoric acid. The pyrophosphate of magnesia solution obtained from this precipitate showed a trace of iron with sulphocyanide of potassium.

In the presence of a considerable proportion of salammoniac the amount of precipitate was always a little too low; as was the case when the solution was much diluted.

The author made another series of experiments. A solution in which the amounts of iron and aluminium greatly exceeded the proportion of phosphoric acid, as when the acid is estimated in a hydrochloric extract of a soil. He prepared a solution that contained in a litre 20 grammes of iron, as chloride, 2 grammes of aluminium, as chloride, and 0·01 gramme of phosphoric acid. By the direct precipitation of 100 c.c. of this solution with the molybdenic solution, 0·00991 of phosphoric acid was obtained. 100 c.c. of the same solution evaporated to dryness on a water-bath, and the residue dissolved in the smallest amount of nitric acid, also gave 0.00991 of phosphoric acid. 100 c.c. evaporated, and the residue dissolved in the least possible amount of hydrochloric acid, gave only 0·00972 phosphoric acid.

The above results will serve to guide analysts in the use of the process mentioned for determining phosphoric acid. We ought perhaps to state that the author prepares his molybdic solution by dissolving one part of molybdic acid in four parts of ammonia, sp. gr. 0·96, and adding to the solution fifteen parts of pure nitric acid, sp. gr. 1·2. In making the determinations, the phosphoric and molybdic solutions are mixed hot, and are kept at 65° C. for six hours, and then allowed to stand for twenty-four hours. The precipitate is then collected on a filter and washed with equal parts of the molybdic solution and water.

Reactions of Gelatine, by M. Carey Lea, *Philadelphia*

I have been occupied at times for some years past with the study of this very interesting substance, and propose here to describe a new reaction which I have observed, and which constitutes, I believe, the first coloured reaction described as produced between pure gelatine and a perfectly colourless reagent. It is true that the precipitate produced in gelatine solutions by gallotannic acid is much deeper in colour than the precipitant. But the straw yellow colour of gallotannic acid naturally leads to the expectation of coloured combinations, whereas in the case I am about to mention, the precipitant is colourless, and the production of a marked colour seems to point to a more complete action than that of simple combination.

When a piece of gelatine is dropped into an acid solution of pernitrate of mercury, it gradually assumes a strong red colouration, and after a time dissolves in it completely, at ordinary temperatures, to a fine red solution. This solution deepens a little if boiled for some minutes.

By chlorate of potash the hot solution is quickly decolourised, and passes to a pale dirty yellow.

This red colouration seems to require a certain amount of time for its production, which cannot be replaced by heat. If a piece of gelatine be immersed in the solution of protonitrate and boiled for some minutes it is dissolved, but the solution thus obtained is not red, but yellowish.

It is to be regretted that the reaction here described is not more delicate. It is only striking when tolerably strong solutions of gelatine are employed. When the solution is very weak, as, for example, if the gelatine constitutes only one-half of 1 per cent. of the mixed liquids, the limit of the delicacy of the test is reached. Such a solution by standing twenty-four hours exhibits a light but distinct pink colour. Although this delicacy is not what may be desired, still colloid organic substances are so comparatively difficult of qualitative detection as a general thing, that the method is not without value.

The experiment was next extended to meta-gelatine. A neutral meta-gelatine was prepared in the following manner:—

Gelatine was set to swell in cold saturated solution of oxalic acid, and then a moderate heat was applied for a sufficiently long time for the mass to remain quite fluid when cold. It was then agitated with precipitated carbonate of lime until the whole of the oxalic acid was got rid of. Meta-gelatine prepared in this way was kept for months in a corked phial, in a warm room, without showing any disposition to putrefy. It was almost as fluid as water; perfectly neutral, and almost insipid to the taste.

With this meta-gelatine, the red colouration was produced even more decidedly than with ordinary gelatine. The addition of the acid solution of pernitrate of mercury produced at first a whitish flocculent precipitate, which, by standing, acquired a strong red colour, as did the supernatant liquid.—*American Journal of Science and Arts*, vol. xi., No. 118.

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* Abstract from *Zeitschrift für Analyt. Chem.*, No. 4, 1864, p. 447.

On the Supposed Nature of Air prior to the Discovery of Oxygen, by GEORGE F. RODWELL, *F.C.S.*

(*Continued from page 64.*)

In the 17th experiment Boyle describes the way he adopted to determine the degree of exhaustion of a receiver. In his first attempts he placed a securely closed bladder containing a small quantity of air in the receiver to be exhausted, and considered the exhaustion good when the bladder was fully inflated. He afterwards measured the exhaustion by a small U tube, closed at one end, which was filled with mercury, and a small bubble of air then passed into the closed end. The tube was placed in the vessel to be exhausted, and the rarefaction judged of by the expansion of the bubble of air.

Experiment 18. "About an easie way to make the pressure of the air sensible to the touch of those who doubt it." In order to effect this, Boyle constructed a small brass receiver of the form of a truncated cone, open above and below; the upper orifice was 1¼ inch diameter, and the lower, which stood on the air pump plate, 2½ inches. "The person," he writes, "that would not believe the pressure of the air to be near so considerable as was represented was bidden to lay the palm of his hand upon the upper orifice, and being ordered to lean a little upon it, that so the lower part of his hand might prove a close cover to the receiver, one exsuction of the air was made by help of the pump; and then upon the withdrawing of the greatest part of the pressure of the internal air, that before counterbalanced that of the external, the hand being left alone to support the weight of the ambient air, would be pressed inwards so forcibly that, though the stronger sort of men were able (though not without much adoe) to take off their hands, yet the weaker sort of tryers could not do it (especially if by a second suck the little receiver were better exhausted), but were fain to stay for the return of the air into the receiver to assist them."

Experiment 31. A magnet was loaded with the utmost weight it could carry. It was then introduced into a receiver. On exhausting, the weight still continued to be supported.

Experiment 32. A small brass syringe was taken, and the piston forced to the bottom of it, the orifice of the syring was then closed securely; when the piston was raised, great resistance was felt, and on releasing it the pressure of the air of course caused it to return to its former position. It was now placed in a receiver, and the piston handle placed in communication with the stopper of the receiver by a piece of string, so that by turning the stopper the string was shortened, and the piston consequently raised; when the receiver was exhausted, the piston was easily raised to the top of the syringe, when it was kept in that position, and air admitted, the piston was immediately impelled to the bottom of the syringe, and the string which held it was broken. The above experiment was varied by suspending a closed syringe in the air pump receiver by its piston rod, and attaching a weight to the barrel not sufficient to draw it down—in other words, not sufficient to overcome the pressure of the air on the area of the piston. On exhausting, the barrel immediately descended, and when air was admitted it rose to its former position, dragging up the weight with it.

Experiment 34. A syringe was placed in a receiver in such a manner that its piston could be raised when the receiver was exhausted; a glass tube was fitted to its nozzle, and its lower orifice caused to dip into mercury; on exhausting, and raising the piston, the mercury was observed not to follow it, but when air was admitted it immediately rose to the piston.

Experiment 35. A cupping glass was attached to the palm of a person's hand by the usual method; the hand was then made to act as a cover to a small receiver; on exhausting, the cupping glass fell down.

Experiment 40. Some small feathers were detached from the top of a tall receiver; before exhaustion they fell slowly, and wavered in their course; after exhausting the receiver, they fell "like a dead weight."

Experiment 43. Sugar was submitted to friction in an exhausted receiver, and was found to emit light as readily as in air.

Experiment 45. In order to ascertain whether heat could be produced by friction in an exhausted receiver, a concave piece of brass was fixed to the air pump plate, a convex piece of the same metal was connected with a rod which passed air-tight through the cover of the receiver, and could be turned by a handle, when the two surfaces were rubbed together in vacuo, a considerable amount of heat was found to be produced.

Experiment 46. Quicklime was slaked in an exhausted receiver, and heat was found to be produced as readily as when it was slaked in air.

With this experiment we conclude our notice of Boyle's second pneumatical treatise; there are altogether fifty experiments, of these we have noticed the most important, omitting those which are only slightly modified forms of experiments described in the former treatise.

PHARMACY, TOXICOLOGY, &c.

On Tobacco, by FERDINAND F. MAYER, *of New York.*

NUMEROUS as have been the essays published both on the chemical and the therapeutical relations of *Nicotiana Tabacum* and its narcotic principle, they refer for the greater part to the leaf of the usual brown colour and well-known irritating ammoniacal odour, which is the form officinal in all Pharmacopœias; for, though universally cultivated, the plant is never prepared specially for application in medicine like other narcotics, partly because of the commercial article being still more readily obtainable, but in yet greater measure, because the fresh and the dried green leaves have very generally been considered, if not devoid, to be at least of very feeble developed medicinal virtues. Only those of another species, *N. rustica*, are occasionally used fresh as an external application, and are, or were formerly officinal in some European Pharmacopœias.

There is so striking a difference in many of the outer properties of the officinal plant, in the green and the cured condition, as to offer in itself some grounds, for what was formerly universally and is even now very generally believed, that the volatile alkaloid on which the activity of brown tobacco is supposed to depend was not present as such in the living plant, but that it is a posthumous product formed entirely or partly during that incomplete fermentation which it undergoes in the hands of the cultivator, the "bulking" of tobacco. For, the fresh plant possesses none of the peculiar heavy odour of the other narcotics. Nor is the dried leaf much more pungent than a common herb. Its infusion, like the fresh juice, has an acid reaction, and contains no ammonia. Its colour is pale green, with here and there some brownish patches; but the taste is decidedly acrid, and certainly only differs from that of the commercial article by the absence of free ammonia. It also contains a large proportion of nicotina in combination.

This had been pointed out as early as 1809 by Vauquelin, in the report made by him with Robiquet and U.S. Consul Warden. It was again shown to be present by Posselt and Reimann, in 1831, in plants of several species grown near Heidelberg, and again in 1836 by Henry and Boutron-Charlard; and in 1831 A. Buchner, sen., prepared some nicotina from the seeds. Lastly, our excellent Proctor, in 1858, proved without doubt the presence of the alkaloid at least in the fresh leaves; and the authority on whose credit the origin by fermentation had been maintained, corrected the statement made there as early as 1844, upon the occasion of a paper on tobacco smoke by A. Melsens, in a note to which (*Annalen der Chemie und Pharmacie*, vol. 49, p. 359) Liebig mentions that "at the Giessen Laboratory not inconsiderable quantities of the alkaloid had been obtained from the fresh plant."

With such evidence the presence of nicotina in the plant, through its various stages, may be accepted as satisfactorily proved. Yet Mr. Proctor suggested that the matter, especially in regard to the seed, be again made the subject of research, and since this investigation has been undertaken by me, fresh interest has been imparted to it by the publication of a paper on the same subject in the *Vierteljahresschrift für Pharmacie* of April last. The author of this essay found a volatile principle, which on the strength of its odour he assumes to be trimethylina (pseudo-propylamin,) said to have originated from a fermentable substance contained in the seed, and he believes that Buchner mistook a mixture of ammonia and trimethylina for nicotina.

In order to avoid, if possible, errors arising from reliance upon such deceptive characteristics as odour, and because in the examination of the plant at least two bases are met with possessing a pungent and somewhat similar odour, I have made use, besides the usual distinction resting on the percentages of platinum in the double salts of the volatile bases, of the following table founded on previous and new observations of Nessler, Winckler, Proctor, myself, and others:—

Principal Reactions of the Medicinal Volatile Bases.

(*w.* = watery solution; *s.* = salts, or acid solutions.)

Reagents added to	Ammonia.	Trimethylina.	Anilina.	Nicotina.	Conia.	Lobelina
Iodine in Iodide of Potassium	*w.* Decolorised. *s.* No change.	*w.* and *s.* Orange-coloured precipitate.	Brown solution; afterwards a precipitate, or none.	*w.* and *s.* Brownish red precipitate.	*w.* and *s.* Pale brownish-red precipitate.	*w.* and *s.* Brownish red precipitate.
Tannic Acid	*w.* No precipitate. *s.* Precipitate of tannin if concentrated.	Neutral and alkaline solutions; white, curdy precipitate.	No precipitate.	Whitish precipitate, soluble in acids.	White precipitate, soluble in tannic and other acids.	White precipitate, soluble in tannin and ammonia.
Chloride of Mercury	*w.* White precipitate.	*w.* White precipitate.	No precipitate.	*w.* White precipitate.	*w.* White precipitate.	*w.* No precipitate.
Iodohydrargyrate of Potassium	*s.* No precipitate; with caustic KO orange to brown precipitate. *w.* White to yellow precipitate, soluble in excess.	*s.* A loose mass of pale yellow crystals, very soluble in excess of iodide of potassium, and caustic KO; decomposed by shaking with water. *w.* Precipitate which re-dissolves in excess.	*w.* Solution; white precipitate, soluble in excess and in KI, reproduced by KO, but re-dissolved by excess of the same.	*w.* and *s.* Yellowish precipitate, somewhat soluble in excess of re-agent, and readily soluble in caustic KO.	*w.* and *s.* Same as nicotina.	*w.* and *s.* Pale yellow precipitate, little soluble in excess of re-agent or of caustic KO.
*Acetate of Lead**	....	....	....	....	....	....
Nitrate of Silver	*w.* Brownish-black.	*w.* Greyish, soluble in nitric acid.	No precipitate.	*w.* At first no precipitate, but a brownish-black one on heating.	*w.* White precipitate, turning brownish, soluble in ammonia, at first also in nitric acid.	*w.* White precipitate, soluble in ammonia and nitric acid.
Chloride of Gold	*w.* Reddish-yellow precipitate.	*w.* Greyish-yellow, insoluble in hydrochloric acid.	*w.* No precipitate.	*w.* Yellowish, curdy, insoluble in HCl.	*w.* Whitish, insoluble in HCl.	*w.* Pale yellow, insoluble in HCl.
Chloride of Platinum†	....	....	....	....	....	....
Density and Solubility	Very soluble; mixes with water.	Very soluble; mixes.	Scarcely soluble; floats.	Little soluble; sinks.	Little soluble; floats.	Little soluble; floats.

* In the watery solution, except of *anilina*, a white precipitate. † Distinct precipitate only from *nicotina*, which dissolves on heating.

Course of Proceeding.—The volatile alkaline substance having been obtained in form of a concentrated solution in water, and in part as solution in hydrochloric acid, a drop of a solution of iodide of potassium saturated with iodide of mercury is added to part of the acidulated solution. Either,

I. It produces no precipitate.—Absence of trimethylina, nicotina, lobelina, conia. To a portion of the unchanged solution add caustic potassa in slight excess, which causes a precipitate. It is—

Whitish and pulverulent: anilina.

Reddish to brown and flocculent: ammonia.

II. A precipitate is produced.—Add excess of the solution of mercury.

1. The precipitate re-dissolves very readily: trimethylina.

2. The precipitate is scarcely soluble in excess of mercury, but readily, while fresh, in caustic potassa: nicotina, conia. Apply the specific tests.

3. The precipitate is scarcely soluble in either: lobelina.‡

(To be continued.)

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‡ Ammonia.—Its reactions, as, for instance, that with cobalt, are rendered indistinct by the presence of carbonic acid.

Commercial trimethylina (the medicinal propylamin) is probably never free from ammonia, which is readily ascertained in an acid solution by the test with iodohydrargyrate and caustic potassa. It should be perfectly colourless and clear, of a faint odour of ergot rather than of herring, and must burn like alcohol.

Conia, when quite pure, is colourless, and has a peculiarly sweet, but rancid or somewhat musty odour. Lobelina resembles it in many respects; has an herbaceous odour, recalling that of Prussic acid.

The alkaloids tested were freshly prepared for the experiments by the method described further on for nicotina.

PROCEEDINGS OF SOCIETIES.

COLLEGE OF PHYSICIANS.

Wednesday, May 3, 1865.

"*On Animal Chemistry.*" A course of Six Lectures by WILLIAM ODLING, M.B., F.R.S., F.R.C.P.

LECTURE 3.

***Recapitulation**—Statical and dynamical aspects of organic chemistry—Destruction and construction of constituent aplone molecules—Tendency of oxidation to produce molecules with fewer and fewer carbon and hydrogen atoms—Final production of carbonic anhydride CO_2, and water H_2O—Destructive or analytic phase of organic chemistry—Natural synthesis of organic compounds attended by deoxidation—Liberation of oxygen by growing vegetables—Tendency of deoxidation to combine separate carbon and hydrogen atoms into complex molecules—Vegetable tissue and secretion formed by deoxidation of carbonic anhydride and water—Imperfect knowledge of intermediate products—Formation of nitrogenised tissues—Ammonia in its relations to plant-life—Correlations of ammonia, nitrous acid, and nitrogen—Deoxidation of nitrous acid by plants—Manurial equivalency of nitrous acid and ammonia—Existence of nitrogen in natural organic products as a residue of ammonia—Artificial synthesis of organic bodies—Combination of constituent molecules with one another—Elementary formation of constituent molecules—Historical remarks on organic synthesis—Alleged incompetency of chemical, and necessity for vital action—Artificial production of all organic compounds by purely chemical means—Kolbe's indirect formation of acetic acid from carbon, hydrogen, and oxygen, in 1845—Subsequent advances by Berthelot and others—Oxidation of hydrogen into water, and of carbon into carbonic anhydride—Evolution of light and heat—Deoxidation of water and carbonic anhydride into hydrogen and carbon—Similar separations of carbon and hydrogen effected by living plant and by artificial processes—Comparison of deoxidising vegetal and oxidising animal functions—Nature of forces concerned in respective actions.*

I OBSERVED in my last lecture that chemists were acquainted with a great number of monobasic organic acids, containing two atoms of oxygen in their respective molecules, and that these acids were capable of being arranged in two principal classes, known as the aromatic class and the fatty class, as exemplified in the accompanying lists:—

Fatty Acids.		Aromatic Acids.	
Formic	$C\ H_2\ O_2$	Collic	$C_6\ H_4\ O_2$
Acetic	$C_2\ H_4\ O_2$	Benzoic	$C_7\ H_6\ O_2$
Propionic	$C_3\ H_6\ O_2$	Toluic	$C_8\ H_8\ O_2$
Butyric	$C_4\ H_8\ O_2$	Picic	$C_9\ H_{10}O_2$
Valeric	$C_5\ H_{10}O_2$	Cuminic	$C_{10}H_{12}O_2$
"	"		
Melissic	$C_{34}H_{60}O_2$		

The acids of these two series presented, I told you, a marked parallelism in their constitution, seriation, and properties; and, moreover, when submitted to the action of the same chemical reagents, underwent precisely similar metamorphoses. I dwelt still more upon the mutual resemblance manifested by consecutive members of the same series, and pointed out that even the most remote members were distinguished from one another by gradational differences only. I observed, also that each one of these primary monobasic acids, fatty or aromatic, was associated with a more or less complete set of congeners, which differed from it in constitution and properties, but were correlated with it by the circumstance of their containing the same number of carbon atoms, and still more markedly by their derivation from, and convertibility into it and one another—that acetic acid $C_2H_4O_2$, for instance, was associated with the less oxidised bodies, olefiant gas C_2H_4, alcohol C_2H_6O, and aldehyde C_2H_4O, as well as with the more highly oxidised glycolic and oxalic acids, $C_2H_4O_3$ and $C_2H_2O_4$ respectively—to such an extent, indeed, they might all be regarded as varieties of one and the same primitive molecule. I further went on to say that the complex tissue products of the animal and vegetable kingdoms were built up of the residues of these fatty and aromatic acids, and of their respective congeners; so that upon breaking up such tissue products into their constituent molecules, we were, in the great majority of instances, able, even at the present time, to refer the constituent molecules to their appropriate positions in certain definite series and groups, and had every reason to believe that with increasing knowledge we should be able to make the assignment in every instance. Again, in my first lecture, I pointed out to you that organic chemistry had a statical aspect which related to the composition of bodies, and a dynamical aspect which related to their changes of composition.

Now, in all that I have hitherto observed, I have had regard principally to the statical aspect of the question. I have, indeed, glanced at the mutual metamorphosis by oxidation and deoxidation of compounds belonging to the same natural group, and have referred more fully to the combination of different residues with one another in forming complex tissue products, and to the separation of the completed residues from one another in the breaking up of these products; but I have not considered the mode in which the primary constituent molecules are themselves produced, or yet the mode in which, when once produced, it is possible for us to destroy them, and to these points I will now direct your attention.

If we treat the more complex members of our series of fatty acids, for instance, with powerful oxydising agents, we obtain bodies in which the number of the constituent atoms of carbon and hydrogen becomes progressively less and less, until we arrive at bodies containing only two, and finally at bodies containing only one atom of carbon. In some cases these successive oxidation products are found to contain the same number of atoms of oxygen as the bodies from which they were produced, though in the majority of instances they contain a greater number, and, consequently belong to more oxygenised series. But whether they contain the same or a greater number of oxygen atoms, we find that the number of atoms of carbon and hydrogen becomes gradually less and less, or that the molecules pertain to simpler and simpler groupings. For example, the following intermediate compounds, among many others, have been successively obtained by oxidising stearic acid $C_{17}H_{34}O_2$, with nitric acid of moderate strength:—

Oxidation Products.

Rutic acid	$C_{10}H_{20}O_2$	
Suberic		$C_8H_{14}O_4$
Œnanthoic	$C_7\ H_{14}O_2$	
Pimelic		$C_7H_{12}O_4$
Caproic	$C_6\ H_{12}O_2$	
Adipic		$C_6H_{10}O_4$
Butyric	$C_4\ H_8\ O_2$	
Succinic		$C_4H_6\ O_4$

The tendency of oxidation, then, is to separate the constituent carbon and hydrogen atoms from one another until at last there is left only the most stable mono-carbon compound known to chemists, namely, carbonic anhydride, or, as it is frequently called, carbonic acid. No matter what the complexity of the original molecule, the chemist eventually succeeds in transforming it by oxidation, through a series of less and less complex molecules into carbonic anhydride, or oxide of carbon, on the one hand, and water, or oxide of hydrogen, on the other—the identical bodies out of which the vegetable organism directly, and the animal organism indirectly, constructs those complex bodies which we have designated as proximate organic principles. As was observed by Gerhardt some twenty years ago, one of the two extremities of the scale of organic compounds is occupied by such bodies as albumen, and gelatine, and fat, and cerebral matter; the other extremity by carbonic acid, and water, and ammonia; while an infinity of bodies are included in the interval. The chemist, by treating the superior substances with oxidising agents, gradually descends the scale of complexity, converting these substances into more and more simple products, by successively burning off a portion of their carbon and hydrogen.

Thus, then, we have presented to us one important aspect of organic chemistry, namely, its analytic or destructive aspect; that aspect upon which, until of late years, the attention of chemists was almost exclusively directed; that aspect, indeed, which was at one time considered to be the only possible aspect which could ever be presented. To quote again from the same distinguished chemist, of whom I am always proud to avow myself a pupil: "I show," said Gerhardt, writing in 1842, "how the chemist does everything that is contrary to living nature—that he burns, destroys, works by analysis—the vital force alone operates by synthesis and reconstructs the edifice destroyed by chemical forces." But, in reality, there is another side to the shield; there is a constructive as well as a destructive, a synthetic as well as an analytic, chemistry; and to this view of the subject I will now direct your attention.

I need scarcely remind you of the mode in which vegetable structures are originally built up. The minute seed grows into the gigantic tree, the great mass of which is made up of carbon, hydrogen, and oxygen, which the living organism has stored up from the carbonic acid and water with which it has been supplied throughout the period of its existence, and which it has intercombined into the various forms of vegetable tissue. Now, this storing up of carbon, hydrogen, and oxygen, this formation of vegetable compounds, is attended throughout by an evolution of oxygen. The proportion of oxygen contained in carbonic acid and water being greatly in excess of the proportion contained in vegetable tissue and secretion, we have throughout the growth of every plant a constant deoxidation of carbonic acid and water—the carbon, hydrogen, and necessary oxygen being retained in the substance of the plant, the oxygen in excess of the requirement of the plant being discharged into the atmosphere. Let me recall to your recollection one of the original experiments of Priestley upon this subject. He showed, for example, that under exposure to sunlight a quickly-growing leafy plant, immersed in an atmosphere which by the combustion of fuel, had been freed from oxygen and charged with carbonic acid, gradually restored that atmosphere to its pristine condition, by an absorption and subsequent decomposition of its carbonic acid, into oxygen gas evolved from the leaves, and carbon retained within the vegetable organism. Here we have an imitation of the experiment. A bunch of fresh mint has been thrust into this narrow upright cylinder of dilute carbonic acid water standing in the small pneumatic trough, and the whole exposed to sunlight. You perceive that the leaves are now covered all over with minute beads of gas, and that a small but appreciable quantity of gas has collected at the top of the cylinder. By pulling the attached thread I am able to withdraw the bunch of mint, and on now passing up a few bubbles of nitric oxide, a dark-brown vapour is produced, proving the presence of oxygen in the gas which had accumulated at the top of the cylinder, which oxygen, thus evolved by the growing plant, was separated by the plant from the carbonic acid, or hydrated oxide of carbon, by which it was surrounded.

Now, just as oxidation tends to separate the constituent carbon and hydrogen atoms of a complex organic molecule so as to produce simpler and simpler molecules, so, on the other hand, do we find that deoxidation tends to combine the separated carbon and hydrogen atoms into more and more complex molecules. The organism of a plant, for instance, operating upon mono-carbon compounds only, effects simultaneously their deoxidation and inter-combination. It deoxidates them with evolution of oxygen into the atmosphere, and combines the residual less oxygenated carbon and hydrogen into the various forms of vegetable tissue and secretion. What the intermediate stages are between water and carbonic acid, on the one hand, and some vegetable principle such as mannite or sugar on the other, we cannot at present say, though our knowledge upon the subject is receiving daily accessions. But be our acquaintance with the intermediate stages ever so imperfect, the final result is perfectly intelligible. We know, for instance, that in the production of this body, mannite, there has been a deoxidation of six molecules of carbonic anhydride and seven molecules of water, and that in the course of the deoxidation the thirteen separate molecules have been conjoined into one single molecule, thus:

$$\begin{array}{ccccccc} \text{Carbonic anhyd.} & & \text{Water.} & & \text{Oxygen.} & & \text{Mannite.} \\ 6\,CO_2 & + & 7\,H_2O & - & 13\,O & = & 1\,C_6H_{14}O_6. \end{array}$$

This, then, is the point which I wish to bring prominently under your notice—that while oxidation tends to the separation of atoms, and the formation of simple out of complex bodies, deoxidation, as manifested in the vegetable kingdom, tends to the combination of atoms, to the formation of complex bodies out of simple ones.

Now, the chemist in his laboratory can imitate, however crudely, the synthesis of nature. We find in the laboratory, as in the organism, that deoxidation, actual or potential, leads to the conjunction of atoms, and to the building up of complex molecules. In broad antagonism to the doctrines which only a few years back were regarded as indisputable, we now find that the chemist, like the plant, is capable of producing from carbonic acid and water a whole host of organic bodies, and we see no reason to question his ultimate capability to reproduce all animal and vegetable principles whatsoever.

But for the production of certain organic principles, whether by natural or artificial means, something more than carbonic acid and water is required. The albuminoid bodies, in particular, cannot be formed without nitrogen, and plants, in general, cannot grow without a supply of ammonia or some transformable compound. You will observe, however, that ammonia, considered as a pabulum for plants, differs in this important respect from both carbonic anhydride and water, that it is not susceptible of deoxidation, so that the characteristic chemical action of plant-life cannot be exerted upon it. On the contrary, ammonia is the most thoroughly deoxidised, or rather hydrogenetted, compound of nitrogen with which chemists are acquainted. Even nitrogen itself may be looked upon as less deoxidised than ammonia, being intermediate between ammonia and nitrous acid, thus:—

Nitrogen molecules.

HNO_3	Nitric acid.
HNO_2	Nitrous acid.
NN	Nitrogen.
H_3N	Ammonia.

The nitric and nitrous acids being regarded as oxidised forms of nitrogen, ammonia may be regarded as a deoxidised form, the element *quoad* its state of oxidation being strictly intermediate between ammonia and nitrous acid, as I hope to render experimentally evident to you.

Thus, on passing a series of electric sparks from the Rühmkorff machine through the moist air contained in this apparently empty glass cylinder, a portion of the nitrogen of the contained air becomes gradually oxidised, and after a short time we shall see brown nitrous fumes make their appearance. By allowing the experiment to continue, the depth of colour in the cylinder will go on increasing so as to be visible all over the theatre. But I dare say I shall be able to render the nitrous acid already produced abundantly manifest by allowing it to act upon a piece of paper stencilled with starch and iodide of potassium solution. That we have really obtained a considerable amount of nitrous acid, by the few sparks which have already passed through the air in the cylinder, is shown by the speedy liberation of iodine from the iodide of potassium, and consequent appearance of the word NITROUS in purple characters upon the prepared paper.

Now for the reverse experiment. In this flask is a mixture of materials for generating hydrogen, namely, a little granulated zinc, iron borings, and warm solution of potash. Active effervescence quickly takes place, and the evolved gas, which is without action upon turmeric paper, as you perceive, burns with the characteristic flame of hydrogen. If we now absorb the brown nitrous fumes contained in this bottle, by agitation with aqueous potash, and pour the solution so obtained of nitrite and nitrate of potassium into our hydrogen flask, you observe that the effervescence becomes more rapid, and that the evolved gas is now decidedly ammoniacal, as shown by its browning the turmeric paper and fuming with the hydrochloric acid vapour I bring into its neighbourhood. The reaction taking place is represented in this equation;

Nitrous acid. Hydrogen. Water. Ammonia.

$$HNO_2 + H_6 = 2H_2O + H_3N$$

so that not only is oxygen taken away from, but hydrogen is added to the nitrogen of our original nitrous acid.

By combining the oxidised form of nitrogen, or nitrous acid HNO_2, with the hydrogenetted form of nitrogen, or ammonia NH_3, we obtain nitrite of ammonia NH_3HNO_2, a neutral crystallisable salt, whose somewhat concentrated solution is contained in this flask-retort. Now, on applying heat to the retort, observe what takes place. There is, you see, a copious evolution of gas, some of which we will collect over the pneumatic trough, and, in order to save time, will content ourselves with only a small cylinder full. The gas, produced in this manner from the nitrite of ammonia solution in the retort, is nitrogen, and accordingly you see it has the property of extinguishing flame. In this decomposition the hydrogen of the ammonia exactly suffices to remove the excess of oxygen from the nitrous acid, whereby the nitrogen of both constituents of the salt is simultaneously liberated, thus:—

Ammonia nitrite. Water. Nitrogen.

$$NHHNO_2 = 2H_2O + N_2$$

Hence nitrogen may be looked upon as exactly intermediate in its state of oxidation between nitrous acid on the one hand, and ammonia on the other, while ammonia must be considered the extreme product of deoxidation. Accordingly, it has been found as a general result both of laboratory and field experiments, the latter conducted more especially by Messrs. Lawes and Gilbert in this country, that cereals and other plants thrive equally well upon salts of nitrous or nitric acid as upon salts of ammonia; and that when a plant is supplied with water, carbonic acid, and nitrous acid, it exerts upon the nitrous acid the same sort of reducing action that it does upon the carbonic acid and water, whereby not only farinaceous, but ammoniated or nitrogenised principles are abundantly produced; while some chemists have even maintained that nitrous acid, rather than ammonia, forms the normal nitrogenous food of plants.

Be this as it may, in all animal and vegetable nitrogeinsed products of which the constitution is understood we know, and in all other nitrogenised principles have good reason to believe, that the constituent nitrogen exists as a group apart—as a residue of, or proxy for, ammonia—ready on the occurrence of suitable conditions to regenerate that ammonia. As was observed by Laurent some ten years ago, "nitrogen does not enter into the constitution of organic substances on the same footing, so to speak, as do the other bodies. Organic compounds seem to consist of carbon, hydrogen, and oxygen only; whilst nitrogen exists therein but as the representative of ammonia on the one hand, or of nitric acid on the other." In organic compounds of natural origin, nitrogen occurs only as a residue of ammonia; whilst in organic compounds of artificial origin, it occurs sometimes as a residue of ammonia, as in cyanogen C_2N_2, sometimes as a residue of nitric acid, as in azobenzide $C_{12}H_{10}N_2$.

In the artificial formation of organic compounds, then, there are, as I have said, two distinct points for our consideration, namely, the building up of the primary oxihydrocarbon molecules, and the combination of the residues of these constituent molecules with one another, and with ammonia, to form complex organic principles. Now, the power of combining the residues of aplone molecules with one another, so as to form more or less complex bodies, has been in the possession of chemists from almost the earliest days of organic chemistry, and has been fully recognised to be in their possession. But, somewhat strangely, it is only of late years that this well-known power has been applied to the construction of some of the most familiar components of animal and vegetable bodies. It is only of late years, for instance, that chemists have produced stearine, by putting together the residues of glycerine and the fatty acid; or sarcocine, by putting together the residues of acetic acid and methylamine; or hippuric acid, by putting together the residues of benzoic acid and glycocine; or taurine, by putting together the residues of isethionic acid and ammonia, &c., as referred to in my last lecture. It must be observed, however, that the neglect of these syntheses arose not so much from want of interest in the production of the bodies, as from want of knowledge of their intimate constitution. No sooner, for instance, was the constitution of these four compounds satisfactorily made out than they were obtained artificially by Berthelot, Volhard, Dessaignes, and Strecker and Kolbe respectively; and as it has been with these, so doubtless will it be with many other complex tissue products, with the constitution of which we are as yet imperfectly acquainted.

The first stage of the process of organic synthesis, however, or the building up of the primary oxihydrocarbon molecules, was considered until very recently as altogether beyond the art of the chemist. It used to be thought that chemistry was essentially incompetent to the production not only of organised, but of organic bodies. For the production of these bodies, the intervention of some living organism, the expenditure of some vital force—whatever that might be—was considered absolutely necessary. While the constituent atoms of a piece of alum, for instance, were admittedly held together by mere mechanical and chemical forces, the atoms of a piece of sugar, on the other hand, or of a piece of fat, were conceived to be put together in some mysterious way by vital forces. These opinions were originally propounded by Berzelius at a time when perhaps the then state of knowledge fully justified their enunciation. They remained almost unchallenged for a long series of years, and are still asserted in some recent text-books with a degree of dogmatism altogether opposed to the present advanced state of knowledge on the subject.

The great progress recently made in the constructive art of the chemist is, I think, a topic of sufficient interest to warrant me in entering into further detail upon the heretofore-prevailing opinions, which I find expressed very well in the last edition but one of Liebig's Chemical Letters, the last edition that was translated by Dr. Gregory, who, writing in 1851, says:—"We are able to construct a crystal of alum from its elements, namely, sulphur, oxygen, hydrogen, potassium, and aluminum, inasmuch as heat as well as chemical affinity are, within a certain limit, at our free disposal, and thus we can determine the manner of arrangement of the simple and compound elements. But we cannot make an atom of sugar from the elements of sugar, because in their aggregation into the characteristic form of a sugar atom, the vital force co-operates, which is not within the reach of our control, as heat, light, the force of gravity, &c., are to a certain extent. . . . . We may produce atoms of a higher order by combining two, three, four, or more compound organic atoms; we can decompose the more complex into less complex compound atoms; we can produce sugar from wood or starch, and from sugar we can produce oxalic acid, lactic acid, butyric acid, acetic acid, aldehyde, alcohol, formic acid, &c., although we are altogether incapable of producing any of these compounds by a direct combination of their elements."

I might further refer you to Dr. Gregory's deservedly-popular Handbook, of which the last edition appeared in 1857, and to many other works, as showing the general prevalence of these opinions, but content myself with extracting the following series of passages from the most recent of all our chemical text-books. You will see that in this work, published only two years ago, the statements made by Liebig in 1851, and by older chemists long before then, are substantially reiterated. "Organic chemistry is that branch of the science which refers to the properties and composition of organised products, or of substances which have been formed in vegetables and animals under the influence of *life*. . . . . . . The *products*, or those substances which result from artificial processes, are far more numerous than the *educts*, or proximate principles of which organic compounds are considered to be formed. These educts, which, as their name implies, may be extracted in an unaltered state, are the immediate or *proximate* principles of the vegetable or animal structure. . . . . . Some bodies which exist naturally in the vegetable structure, and are regarded as educts, may be artificially produced by a reaction of mineral on organic substances. In all cases, however, either an organic substance or a body derived from the organic kingdom is indispensable to this conversion. . . . The principal sources of hydrocyanic acid are certain metallic cyanides. But these compounds have an organic origin; they are the products of a reaction of organic upon inorganic substances; hence the production of hydrocyanic acid by their decomposition furnishes no exception to the remark above made. Under this point of view, the production of artificial urea from hydrated cyanate of ammonia is simply a conversion of cyanic acid (a derivative of an organic substance) into another organic compound. By no processes yet known can gum, starch, or sugar be produced from their elementary constituents C,H,O; and by the production of alcohol from a mixture of sulphuric acid, olefiant gas, and water, Berthelot has merely proved that a hydrocarbon of organic origin or one derived from organic matter is capable of being converted into another organic product." Thus the view very generally entertained but a few years back was substantially this—that the chemist could not produce organic out of mineral matter; he might transform one kind of organic matter into some allied kind of organic matter—starch into sugar, and olefiant gas into alcohol, for instance; he might produce certain simple organic principles by the breaking up of more complex molecules—oil of spirea, for instance, from salicine, alcohol from sugar, and glycerine from fat; and he might even produce highly complex principles, by a conjunction of two or more simple principles—oil of wintergreen by combining salicylic acid with wood spirit, and fat by combining stearic acid, for instance, with glycerine; but this was the limit of his powers—he might shuffle about the residues of existing organic compounds in a variety of ways, but was utterly unable to produce even the simplest of them by elemental synthesis. Our present knowledge, however, assures that these opinions are altogether without foundation. Already hundreds of organic principles have been built up from their constituent elements, and as I have previously said, there is now no reason to doubt our capability of producing all organic principles whatsoever in a similar manner. Wöhler's artificial production of urea from cyanate of ammonia in 1828, and Pelouze's artificial production of formic from hydrocyanic acid in 1831, were in reality very important pioneering achievements, although cyanogen and its compounds were at that time known only as products of the decomposition of organic bodies. But in 1845 Kolbe produced acetic acid from carbon by a series of strictly inorganic processes, and thereby laid the foundation of modern synthetic chemistry. He observed in his paper on the subject —"From the foregoing observations we deduce the interesting fact that acetic acid, hitherto known only as a product of the oxidation of organic materials, can be built up by almost direct synthesis from its elements. . . . If we could only transform acetic acid into alcohol, and out of the latter could obtain sugar and starch, then we should be enabled to build up these common vegetable principles, by the so-called artificial method, from their most ultimate elements." Relying upon these results, Laurent in his "Methode de Chemie," 1853, and Hofmann in a course of lectures "On Organic Chemistry," delivered the same year at the Royal Institution, the latter, with very great detail, showed how impossible it was to draw the line of demarcation between carbon compounds of organic, and carbon compounds of mineral origin. They both referred to Kolbe's formation from mineral elements of acetic acid or vinegar, and of certain highly complex bodies procurable from vinegar, such as mesidine $C_9H_{13}N$, and nitro-mesidine $C_8H_{12}N_2O_2$. It must be admitted, however, that to the labours of Berthelot, prosecuted unintermittingly for the last ten years, is due that full recognition of synthetic organic chemistry which now obtains, and the very great advances which have recently been made therein, both by himself and by others, which I propose hereafter to bring under your more especial consideration.

Before proceeding, however, to exemplify the powers of organic synthesis in the artificial formation of animal and vegetable products from carbon, hydrogen, and oxygen, I must beg leave to make a rather long digression. I propose, firstly, to bring before you some elementary experiments connected with the production and decomposition of the oxides of carbon and hydrogen, or carbonic anhydride CO_2, and water H_2O, respectively; and then to consider with you what bearing these experiments have upon the forces exerted in animal and vegetable life, or, in other words, upon the so-called vital forces.

I have here an ordinary form of apparatus in which hydrogen gas is being generated in the usual manner from zinc and dilute sulphuric acid, and dried by transmission through oil of vitriol. On burning the jet of dried hydrogen under this cold bell jar, we observe that the interior of the jar becomes quickly covered with a film of condensed steam or water, produced by the direct combustion of the hydrogen gas with the oxygen of the air. Now, by progerly contrived experiments, I might show you that the weight of water produced in this way is exactly equal to the weight of oxygen and hydrogen consumed in the burning. But during the combustion there is a production not only of water but of heat, which I may exhibit to you in a more striking manner. We have here a piece of clean platinum foil, which is now maintained in a state of ignition by the hydrogen flame. I turn off the supply of hydrogen for a minute or so, and before the platinum has become quite cold, turn it on again, when you observe that the metal becomes and continues redhot without inflaming the gas. The mixed hydrogen and air on the surface of the foil combine with one another to form water, and at the same time produce an amount of heat sufficient to maintain the metal in a state of visible ignition. But where does this heat come from? We have a production of heat and a production of water; ought we not to account for the one as intelligibly as we can for the other?

I now take a piece of charcoal, and make it red-hot in the Bunsen gas flame. Here I have a bottle of oxygen, into which we will pour a little lime water to show the result of the action, and now that the piece of charcoal is sufficiently heated, I introduce it into the bottle of oxygen, when combination between the carbon and oxygen takes place, as you perceive, with vivid combustion. In this experiment we have, then, carbonic anhydride or di-oxide of carbon produced, the source of which is perfectly evident. Upon shaking up the clear lime water which we previously introduced, that which was soluble hydrate of calcium becomes insoluble carbonate of calcium or chalk, and accordingly we now have, as you see, a considerable white turbidity produced. If instead of absorbing the carbonic anhydride by lime water in this manner, we were directly or indirectly to weigh it, we should find that its weight was exactly equal to that of the carbon burnt, plus that of the oxygen which served to burn it. But, in addition to carbonic anhydride, there was during the combination an abundant production of light and heat. Now the axiom, that out of nothing comes nothing, is just as true of light and heat as of water and carbonic anhydride. We have no difficulty in understanding the production of the carbonic anhydride; what, however, is the origin of the light and heat?

So much, then, for the formation of oxide of hydrogen or water, and oxide of carbon or carbonic anhydride; now for their decompositions. By a variety of means we are able to separate hydrogen and carbon from their respective combinations with oxygen; one of the most convenient materials for the purpose being metallic sodium. If, for instance, we introduce under this vessel of water a piece of metallic sodium, which, for the sake of convenience, I have diluted with a little mercury, so that the reaction may take place more slowly than it otherwise would, we get, as you perceive, a regular evolution of hydrogen gas. The sodium combines with the oxygen of the water, whilst its hydrogen is set at liberty; and in a similar manner we may liberate carbon from carbonic anhydride, as I will now endeavour to show you. The carbonic anhydride produced by the combustion of a piece of charcoal in this bottle of oxygen was absorbed by means of lime, whereby we obtained a precipitate of chalk, from which by treatment with hydrochloric acid we may easily re-obtain the carbonic anhydride. Thus, if I transfer our mixture of chalk and water into this narrow cylinder standing over the mercurial trough, and then pass up a little hydrochloric acid, you observe that the chalk disappears with effervescence, while a quantity of gas collects at the top of the cylinder, which is the carbonic anhydride gas we lately produced in this bottle by the direct combination of carbon and oxygen. In the arrangement on the table before you we are producing a current of carbonic anhydride in a similar manner by acting upon chalk or, rather, marble, with dilute hydrochloric acid. The gas evolved in the Wolfe's bottle is transmitted over pumice and oil of vitriol to render it dry, and then conveyed to the bottom of an ordinary Florence flask, into which I have dropped a piece of clean metallic sodium. We now apply a large blowpipe flame to the bottom of the flask so as to heat the contained sodium. There is a little practical difficulty in starting the reaction, and perhaps the experiment may not succeed at the first trial, but it is sure to succeed sooner or later. The action is now beginning, and you observe the piece of sodium glowing in the flask. The glowing is soon succeeded by a brilliant combustion, attended by the formation of copious white fumes. The sodium has effected a decomposition of some of the carbonic anhydride, united with its oxygen to form soda, and liberated its carbon in the form of a black mass, which remains, as you see, at the bottom of the flask. This piece of charcoal in the flask has been extracted from carbonic anhydride gas, which is itself producible, as I have shown you, from the direct combustion of charcoal in air or oxygen. By combining hydrogen and oxygen with one another we obtain water, and by acting upon the water with a deoxidising agent we get back the hydrogen. Similarly, by combining carbon and oxygen with one another we obtain carbonic anhydride, and by acting upon the carbonic anhydride with the same deoxidising agent we get back the carbon, as you perceive. When we acted upon oxide of hydrogen with sodium, we separated the oxygen and obtained the hydrogen; when we acted upon oxide of carbon with sodium we separated the oxygen and obtained the carbon. Now the living plant effects a similar decomposition of these two compounds, but in a gradual manner, which we shall hereafter endeavour to imitate. The plant absorbs oxide of hydrogen or water, and oxide of carbon or carbonic anhydride, deoxidises both compounds to a more or less complete extent, evolves the separated oxygen into the atmosphere, and retains the united carbon and hydrogen, with or without some oxygen, in the form of vegetable tissue or secretion. When the tissue or secretion is subjected to a full red heat it yields, among other products, free carbon, free hydrogen, and various compounds of carbon with hydrogen. The piece of wood-charcoal now in my hand, for instance, has resulted indirectly from a gradual deoxidation of carbonic anhydride by the living plant, just as this piece of charcoal in the flask has resulted directly from a violent deoxidation of carbonic anhydride by the metallic sodium.

Thus, then, we have presented to our notice the most important terrene, or rather cosmical function of plant life. The living plant effects a decomposition of carbonic anhydride and water, evolves the liberated oxygen, and retains within its organism the united carbon and hydrogen, which becoming the food of animals, are simultaneously disunited and re-oxidised once more into carbonic anhydride and water. Now, I wish to consider with you—I was going to say more minutely, but I should rather say more broadly—what is the essence of these complimentary actions in their relation to the first principles of that dynamical philosophy which is now often spoken of as the science of energetics. It formed part of my original plan to give a passing glance at this subject, but I certainly should not have ventured to discuss it in the elementary form in which I now propose to bring it under your notice, had it not recently come to my knowledge that certain principles of mechanical philosophy admitted by that class of naturalists who are called physicists to be as fundamental as the law of gravitation itself, are not generally acknowledged by that other class of naturalists who are called physicians. Now, in order to contrast with one another the great antagonistic functions of plants and animals, the decomposition of carbonic anhydride and water by the one class, and recomposition of carbonic acid and water by the other, it would not conduce to my object, even if it were within my competency, to discuss with you the simplest functions of organic life, as manifested in the most minute and simple organisms, in some of which it is scarcely possible for us to distinguish between the animal or vegetable character. Feeling that every phase of life deserves our attentive examination, I am far from insensible to the advantages attending the study of its most elementary forms. But this study cannot, I maintain, teach us the whole truth. There are principles of the highest importance which can only be learned by having regard to the directions in which animal and vegetable life respectively tend—by comparing with another the highly specialised forms of animal and vegetable life, not in their minute details, but in their broad general features. In my next lecture, then, we shall have to consider more especially what is the nature of the force exerted in the characteristic actions of vegetable and animal life—whether we have to do with some peculiar internal vital force, or only with the ordinary external forces of nature, working in a manner strictly parallel to that in which they are habitually exerted in the inorganic world.

ACADEMY OF SCIENCES.

August 7.

M. Cloez communicated a memoir entitled "*Experiments and Observations on Fatty Matters of Vegetable Origin.*" The author's experiments were principally directed to ascertain the nature of the changes produced in drying oils by the action of air and oxygen. He first analysed various oils, and then exposed to air and light at the ordinary temperature 10 grammes of each oil in flat glass dishes lightly covered with unsized paper. The dishes were weighed every three months, to ascertain changes in weight. The whole time of exposure was eighteen months, and in this time M. Cloez found an increase of weight in every instance, but varying from 2·5 to 8·5 per cent. It is remarked, however, that the increase was not constantly progressive during the whole time. At certain times there was a diminution of weight, so that if the phenomenon was represented graphically, there would be a curve gradually rising to a certain maximum, then slowly falling to end by becoming parallel to the axis of the abscissa, but this only after a great lapse of time. The author shows that it is a simple oxidation that takes place. The amount of carbonic acid produced does not represent a quarter of the carbon that disappears. The remainder forms volatile compounds with hydrogen and oxygen, among which he proved the presence of acetic and acrylic acids, and a small quantity of anoleine. The white paper covering the dishes became brown after a time, owing to the action of the volatile compounds formed. He believes the brown colour of the leaves of old books to be owing to the slow oxidation of the oil in the printer's ink. M. Cloez gives a table of the amount of oil present in various seeds, which he determined by extracting with sulphide of carbon. This table we may give on on a future occasion.

M. Dancel presented a memoir "*On the Influence of Water in the Production of Milk.*" The author has noticed that women, when suckling, drink a great deal more than at other times. Cows, too, before they drop a calf will be satisfied with from 12 to 20 litres of water a-day, but afterwards they require 30, 40, or 50 litres. He notices also that cows fed in houses on dry food give a fourth or even a third less milk than when at pasture. He states, too, that cows fed upon dry sesame cake gave very little milk until they were freely supplied with water. He concludes from all this that water has a good deal to do with the secretion of milk.

M. Bechamp read a paper "*On Variations in the Amount of Nefrozymase present in Urine in Different States of the Body.*" Nefrozymase is the soluble ferment discovered by the author in healthy urine. (See Chemical News, vol. xi., p. 116.) The author finds that the proportion of this body is increased by violent exercise. In patients labouring under Bright's disease, and in some cases of paraplegia, it disappears altogether. In advanced diabetes the amount is somewhat increased. Other pathological states seem to influence the proportion; but the matter evidently requires further investigation before the value of the determinations can be estimated. The author states the urine of men contains more than that of women; and in every case the urine of the blood—that is to say, that secreted at night—contains the most. M. Bechamp also states that albumen may be passed in the urine in two forms—one coagulable by heat and alcohol, and then remaining insoluble in water; the other, not coagulable by heat, but precipitated by alcohol and soluble after precipitation. This soluble albumen differs from nefrozymase by having no action on starch paste, which, our readers will remember, is liquefied and changed into glucose by nefrozymase.

NOTICES OF BOOKS.

Chemistry as a Branch of General and Practical Education. By Dr. T. Wood, F.C.S. (Reprinted from the *Social Science Review.*) London: Hutchinson. 1865.

We cannot say that we are struck by either Dr. Wood's matter or style, or, indeed, anything that is exclusively his, though we of course share his opinion that it is extremely desirable that, at all events, the elements of a science which receives more practical applications in every-day life than any other should form a part of every boy's and even girl's education.

Dr. Wood very correctly remarks that school is the place where the foundation of a scientific training must be laid, and for this reason advocates *early* instruction in chemistry. "The real use," (he says in another place) "and value of chemistry to boys as compared with other subjects of education is a matter of opinion, *though it is of great importance at the present time, especially on account of the Government inquiries into matters of education.*"

We may here leave Dr. Wood to give some of the results of the Government inquiries. The Select Committee of the House of Lords on the Public Schools Bill put the three following questions to Professors Huxley and Tyndall; Dr. W. A. Miller, and Dr. W. Sharpey—viz.:—

Question 1.—"In what branches of physical science should instruction be given in our public schools, and what branches, if any, should be excluded?"

Question 2.—"In what manner should that instruction be imparted; should there be periodical examinations of the pupils, and prizes for proficiency; and by whom should such examinations be conducted, and such prizes awarded?"

Question 3.—"Should instruction in science be made imperative by positive enactment, and if not, in what mode should it be promoted and encouraged by the Legislature?"

In answer to the first question Professor Huxley states that he is strongly in favour of confining instruction in science for disciplinal purposes to elementary physics (with incidental chemistry) and botany, with the addition of the outlines of human physiology. A boy well grounded in the rudiments of these sciences would find none of the methods and very few of the conceptions of the others absolutely strange.

In reply to the second the Professor says that the most perfect method of teaching science is that pursued by anatomists, and chemists, who combine lectures with practical demonstrations, and he very properly insists that University rewards should be open to boys who show special aptitude for scientific research.

Dr. Tyndall is no less explicit in his answers. He contends that instruction should be given in elementary physics, comprising under this term the phenomena and laws of gravity, light, heat, sound, electricity, magnetism, and the mechanical properties of air and water.

The first principles of chemistry ought also to be taught in our public schools.

Instruction in these subjects should, in his opinion, be rendered imperative.

He too advocates lectures and demonstrations, but does not at present recommend laboratories and practical instruction.

Dr. Miller's replies we give at length:—

"Answer to Question 1.—I consider that instruction should be given in Mechanics, including the principle of the composition and resolution of forces—centre of gravity, the mechanical powers, the laws of motion.

"2nd. Hydrostatics and Pneumatics, including the principle of fluid pressure, specific gravity, construction of the barometer, the air pump, common pump, and forcing pump: the siphon.

"3rd. Optics, including the general nature of lig laws of reflection and refraction; the formation of images by lenses.

"4th. Heat: the thermometer; latent and specific heat; phenomena of freezing; ebullition; evaporation.

"5th. Electricity: conductors; insulators; electrical machine; Leyden jar; lightning, protection by conductors.

"6th. Chemistry of the non-metallic elements; the atmosphere; combustion; respiration; water; general nature of acids; bases and salts.

"7th. To these should be added, though it cannot be called physical science, a certain amount of Physiology, giving a general view of the functions of the heart, the brain, the lungs, and the stomach in animals, contrasted and compared with the functions of the root, stem, and leaves of plants.

Answer to Question 2:—"The object to be kept in view is not to make accomplished students in physical science, or even to induce the pupils to follow it, but to ensure a knowledge, exact as far as it goes, of the elementary principles of some of the most important branches of science.

"The instruction will be best imparted by lectures, with experimental illustrations and diagrams, with frequent oral and written examinations during the course. There should also be periodical examinations of the pupils, and prizes for proficiency; such periodical examinations to be conducted, and the prizes to be awarded, by examiners who have not been engaged in instructing the pupils examined.

Answer to Question 3:—"Upon this point I speak with less confidence; but I think it might be required that in each school a competent teacher of science should constitute one of the staff of masters, who should give instruction to the pupils who have risen above a certain position in the school."

We believe that we shall better assist in promoting the object Dr. Wood has in view by quoting the above eminent authorities, than by any further reference to the Doctor's pamphlet; but we must quote his reasons for preferring to teach young boys.

"That elder boys do not take to chemistry with the same readiness and earnestness as younger ones is amply shown by the students sent up to the universities and to the several London medical schools. These young men, as a rule, know absolutely nothing of chemistry when they come up; and of those who know nothing of it at the commencement of their studies, but few can be induced to take any reasonable pains to acquire even a superficial knowledge of it. This state of things is slightly improving under the increased facilities afforded of late years, for the early acquirement of familiarity with future studies. It is, however, only necessary for a good chemist to read the prescriptions written by large numbers of the medical profession to discover a lamentable want of accurate chemical knowledge. In further illustration of this point may be mentioned the complaints of some of the examiners of the London Medical Boards, that they are obliged to keep the standard of the chemical part of their examinations lower than it should be, because the men come so badly prepared."

Journal für Practische Chemie. Nos. 8 and 9, 1865.

NUMBER 8 of this journal contains three original papers by Dr. Max Vogel. The first is "*On a New Method of Forming Trichlorphenylic Acid.*" The author passes a rapid stream of chlorine through a solution of sulphophenylate of potash, by which trichlorphenylic acid, acid sulphate of potash, and free hydrochloric are produced.

The next paper is on "*Ethylenviolet.*" The author first describes some attempts to produce Hofmann's Dahlia-blue by a cheaper reagent than iodide of ethyl. He heated an alcoholic solution of rosaniline with the chloride and nono- and bisulphides of ethyl, and also with mercaptan, but found that no one of these bodies produced any change in the rosaniline. He then tried the effect of substituting the corresponding compounds of *ethylene* for the iodide and bromide of ethyl. When aniline red is heated with bromide or iodide of ethylene it requires close observation to see that any change takes place, for rosaniline and its salts are not soluble in the ethylene compounds. But when the solid mass is separated from the supernatant liquor, and dissolved in alcohol, a beautiful violet solution is obtained, which behaves exactly like that prepared by means of iodide of ethyl. The change takes place quicker when an alcoholic solution of rosaniline or fuchsine is used instead of the solid colouring matter. The author names the new colour *Ethylene Violet*, and shows that its composition is analogous to that of Hofmann's ethyl violet. Dichloride of ethylene has no action on rosaniline, but the author shows how the violet blue may be obtained by varying the process, and first heating aniline with the dichloride of ethylene, and treating the resulting product with arsenic acid. Dr. Vogel has also studied the behaviour of other chlorine compounds of alcohol radicals towards rosaniline, and has obtained a beautiful colour by the action of chloride of benzoyl on an alcoholic solution of aniline red.

The author has another paper "*On the Action of Nitrous Acid on Aniline and the Aniline Colours.*" We now give the author's summary, and may return to the paper at a future time. 1. The final product of the action of nitrous acid on aniline and the aniline colours, whether in aqueous or alcoholic solution, is in every instance *a yellow colouring matter*; hence nitrous acid would appear to be an excellent test for aniline colours. 2. The yellow matter obtained from aniline is different to that resulting from solutions of aniline colours. That from aniline colours is reddened by alkalies and again made yellow by acids; that, on the contrary, resulting from aniline is reddened by acids and the yellow is restored by alkalies. 3. The final product of the reaction of nitrous acid gas on solutions of aniline colours is the same for all the colours—namely, a yellow body, to which he gives the name "*Cinalin.*"[*] The cinalin from rosaniline has the composition $C_{40}H_{19}N_2O_{12}$.

No other papers in this number call for notice.

Number 9 contains but two articles which we have not already noticed in other journals. One of these is by Dr. Rube, "*On a Volumetric Method of Estimating Chromates.*" The method is founded on the fact that one equivalent of chromic acid will convert three equivalents of yellow into red prussiate. The chromate is dissolved in water, hydrochloric acid is added to set the chromic acid free, and the solution of yellow prussiate is added until a slight excess of the last is apparent, which is ascertained by placing a drop in contact with a drop of acid solution of perchloride of iron on a white plate.

The other article is by Osann, "*On Antozone,*" in which he shows that the white vapour produced in the slow combustion of phosphorus in moist air which Meissner (see CHEMICAL NEWS, vol. x., p. 2, *et seq.*) took for antozone, is really what Schönbein has already stated—viz., nitrite of ammonia, or atmospheric air metamorphosed into a salt.

North London Industrial Exhibition.—This, the most important of the many local exhibitions which have recently been held in London, was opened on Wednesday last. We must content ourselves now with remarking that it contains an admirable display of philosophical apparatus by many of the first makers in London. We intend to notice the contents in detail on future occasions, but must recommend our readers to pay the exhibition a visit.

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[*] The author writes *Zinalin*, a name he founds upon the resemblance of the new body to *Zinnober* = *Cinnabar*. We therefore translate Zinalin by Cinalin.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

1900. L. A. M. Chaulin, Rue de l'Echiquier, Paris, "An improved process for rendering wood incombustible."

1906. E. Schaub, Manchester, "An improved sizing material to be employed for sizing or dressing yarns preparatory to weaving."—A communication from J. U. Billwiller, St. Gallen, Switzerland.—Petition recorded July 21, 1865.

1914. J. P. Gillard, Paris, "Improvements in the manufacture of soda and carbonate of soda."—July 22, 1865.

1933. A. P. Price, Lincoln's Inn Fields, Middlesex, "Improvements in the manufacture of carbonate of ammonia, and in the utilisation of the product obtained in such manufacture." — A communication from Dr. H Kunheim, Berlin.—July 25, 1865.

1936. W. Richards, Oldbury, Worcestershire, "Certain improvements in the manufacture of sal-ammoniac."

1939. E. Spicer, New Bridge Street, Blackfriars, "Improvements in compositions similar to gunpowder for blasting, for use in ordnance and firearms, and for other purposes."—A communication from P. Nisser, Melbourne, Australia.

1943. F. Pulman, Whitehall Yard, Westminster, and E. Ginman, Woolwich, Kent, "An improved composition for coating ships' bottoms and the surfaces of other vessels or structures which are exposed to the action of sea-water." —July 26, 1865.

1962. F. A. Abel, Woolwich, Kent, "Improvements in compounds for waterproofing and insulating purposes."—July 29, 1865.

1980. A. V. Newton, Chancery Lane, "An improvement in refining petroleum and other hydro-carbon oils." A communication from R. A. Chesebrough, New Rochelle, N.Y., U.S.A.—July 31, 1865.

1986. W. La Penotière, Essex Street, Strand, "An improved composition for coating the bottoms of iron and wooden ships, by which the same are preserved from fouling and the iron from corrosion, whether internally or externally, by sea or other water or moisture, which is applicable to iron of any kind exposed to the action of moisture."—Aug. 1, 1865.

1994. H. Levy, Glasgow, N.B., "Improved means for testing alloys of gold."

2002. W. W. Burdon, Newcastle-upon-Tyne, "Improvements in reducing vegetable fibre to pulp, and in machinery employed therein."

2004. C. Hodgson, Portarlington, Queen's County, Ireland, "Improvements in, and apparatus for, treating peat in bogs and obtaining it therefrom; also applicable to tilling and cultivating land."—Aug. 2, 1865.

Notices to Proceed.

874. A. D. Gasgon, Rue de la Fidélité, Paris, "A new febrifuge and digestive elixir." A communication from A. Gasgon, Ternes, Paris.—Petition recorded March 28, 1865.

1005. W. Weatherley, Chartham, Kent, "Improvements in sizing paper and in the machinery employed therein."—April 8, 1865.

1068. W. Clark, Chancery Lane, "Improvements in the manufacture of a compound or material to be used as a substitute for india-rubber." A communication from H. Lowenburg, New York, U.S.A., and E. Granier, Paris. —April 15, 1865.

1818. G. S. Livesey, Old Kent Road, Surrey, "Improvements in treating ammoniacal liquors for purifying gas and other purposes."—July 10, 1865.

1877. D. M'Cruminen, Gourock, Renfrewshire, N.B., "An improved process of preparing sea-weeds and other vegetable substances for the production of artificial guano, felt, alkaline salts, and iodine."—July 19, 1865.

CORRESPONDENCE.

The Cheltenham Saline Chalybeate Water, Harrogate.

To the Editor of the Chemical News.

Sir,—Having had occasion lately to make several analyses of the water of the above spring, I was surprised to find that it contained a very large quantity of *protochloride of iron* (Fe Cl). The occurrence of this ferruginous compound is quite anomalous, for I do not know of its existence in any other potable water in Europe. Letters from several of the physicians in Harrogate designate it "a great discovery." I sent some of the residue obtained by evaporating a portion of the water to dryness to my friend Dr. W. A. Miller, of King's College, London, and he says, "The reddish-brown powder which you enclosed to me contains abundance of ferrous chloride." On my return from the Continent the directors at Harrogate will publish the complete analysis of the water, with a report. I deem it only right, through the medium of your ably conducted journal, to let your readers know that there is such a remarkable spring in existence. The other ingredients are, protocarbonate of iron, chlorides of calcium, magnesium, sodium, &c.,—no sulphates. In great haste,

I am, &c.

Sheridan Muspratt, M.D., Professor of Chemistry.

College of Chemistry, Liverpool, Aug. 16.

On the Law of Octaves.

To the Editor of the Chemical News.

Sir,—With your permission, I would again call attention to a fact pointed out in a communication of mine, inserted in the Chemical News for August 20, 1864.

If the elements are arranged in the order of their equivalents, with a few slight transpositions, as in the accompanying table, it will be observed that elements belonging to the same group usually appear on the same horizontal line.

	No.		No.		No.		No.		No.		No.		No.		No.
H	1	F	8	Cl	15	Co & Ni	22	Br	29	Pd	36	I	42	Pt & Ir	50
Li	2	Na	9	K	16	Cu	23	Rb	30	Ag	37	Cs	44	Tl	53
G	3	Mg	10	Ca	17	Zn	25	Sr	31	Bd	38	Ba & V	45	Pb	54
Bo	4	Al	11	Cr	19	Y	24	Ce & La	33	U	40	Ta	46	Th	56
C	5	Si	12	Ti	18	In	26	Zr	32	Sn	39	W	47	Hg	52
N	6	P	13	Mn	20	As	27	Di & Mo	34	Sb	41	Nb	48	Bi	55
O	7	S	14	Fe	21	Se	28	Ro & Ru	35	Te	43	Au	49	Os	51

(Note.—Where two elements happen to have the same equivalent, both are designated by the same number.)

It will also be seen that the numbers of analogous elements generally differ either by 7 or by some multiple of seven; in other words, members of the same group stand to each other in the same relation as the extremities of one or more octaves in music. Thus, in the nitrogen group, between nitrogen and phosphorus there are 7 elements; between phosphorus and arsenic, 14; between arsenic and antimony, 14; and lastly, between antimony and bismuth, 14 also.

This peculiar relationship I propose to provisionally term the "Law of Octaves." I am, &c.

John A. R. Newlands, F.C.S.

Laboratory, 19, Great St. Helen's, E.C., August 8, 1865.

MISCELLANEOUS.

Jones v. Fay.—In this case a painter obtained 100*l.* damages from the defendant, a druggist, who prescribed for the plaintiff, and it was alleged caused excessive salivation by the administration of blue pill. The defendant denied having prescribed blue pill; but the jury found a verdict for the above amount. It was said that the defendant does considerable counter practice, and so excites the jealousy of the medical practitioners in his neighbourhood.

Death of Signor Piria.—At the last meeting of the Academy of Sciences, M. Dumas announced the decease of Piria, so well known by his researches on salicine.

Chemistry at Oxford.—Some weeks ago the University of Oxford advertised for a Waynfleete Professor of Chemistry. People not in the secret supposed that Oxford had become so convinced of the importance of chemistry that they intended to endow a second professorship. Dr. Daubeny, however, has made known—and he certainly deserves thanks for the communication—that the new professorship is of more value than the Aldrichian, which Sir B. Brodie now holds, and consequently this gentleman is expected to apply for the new appointment. In the event of his election to it, Dr. Daubeny states that the old professorship will be suppressed, and its endowments applied to other purposes. Of what these other purposes may be the Doctor gives no hint, and it is impossible to conjecture. But we may suggest that the funds would be well applied in the endowment of chemical scholarships or fellowships for students who exhibit special aptitude for original research. There are very few opportunities in England for rewarding a student engaged in the pursuit of science without regard to any practical application of it; and it would look well if the University, which has for ages expended its enormous revenues in the encouragement of learning, which, however much it may adorn, has done very little to materially benefit the human race, were at last to do something to promote a science which has done almost more than any other, and must now be regarded as the most important of all the natural sciences. No one, we believe, is more conscious of the importance of our science than its accomplished Oxford Professor, and chemists will look to him to exert his influence on its behalf.

Gale's Non-Explosive Gunpowder.—Mr. Gale is repeating his experiments in various places with undoubted success, and the subject is attracting much attention. The secret is now made known by the publication of the patent, and we learn that the incombustibility is produced by mixing one part of gunpowder with three or four parts of finely powdered glass. By the addition of this powder every grain of gunpowder is isolated, and thus only those grains are ignited which come immediately in contact with the source of heat. Mr. Gale is not the first who has experimented in this direction. A French and a Russian chemist have both made experiments on the subject. M. Piobert, in 1835, tried a variety of substances, and among them sand. He tried, also, the separate constituents of gunpowder, and of the three gave preference to nitre, which he found to deprive gunpowder of its dangerously explosive character. M. Fadéieff, the Russian, preferred a mixture of wood charcoal and graphite, which he found to be unaffected by moisture. Mr. Hearder has lately found almost any dry compact powder will answer the purpose, and states that pipe-clay, gypsum, or chalk do very well. Our readers know that Mr. Gale only proposes that stored gunpowder, and powder for transport, should be treated with his process. When this powder is required for use the fine glass is separated by means of a sieve, and the question which is engaging attention is whether or not the powder is damaged by being submitted to this treatment. One writer suggests that glass powder is liable to become alkaline, and therefore hygroscopic. Mr. Hearder objects that it may not be possible to separate the glass completely, and therefore the explosive force of the powder must be more or less diminished. The *Reader* mentions some experiments which "seem to show that the addition of the protective powder to ordinary powder has the effect of rendering the explosion more gradual"—an effect which would be valuable if the protective powder were combustible. We have not yet seen any notice of the effect of the glass on the glazing of the powder, any interference with which would seriously affect the quality of the powder, particularly of the finer kinds. On the whole, we must conclude that the practical value of Mr. Gale's invention has yet to be demonstrated. It is indeed very desirable to have a means of rendering gunpowder combustible or non-combustible at will; but to be really available the results must be accomplished with less trouble and risk than is the case with Mr. Gale's process.

Haarlem and Utrecht Prize Questions.—The Dutch Society of Sciences at Haarlem have this year proposed the following questions, the time for which will expire on the 1st of January, 1867:—1. The exact determination of the heat produced by the combustion of the glycerides. 2. A better method than fractional distillation for separating mixed homologous bodies. 3. Researches on the diminution of temperature in the successive strata of the atmosphere, found to be not the same in different latitudes. 4. An illustrated memoir containing exact microscopical researches upon the formation and the development of the egg in the ovary of fishes and birds. 5. A complete monograph on the lichens of Pays-Bas. 6. The precise determination of the density and the dilatation of a mixture of water and methylic alcohol. 7. The exact determination, at different temperatures, of the density of at least five bodies soluble in water. 8. To discover by means of microscopic researches, the cause of the regular non-development of a portion of the seeds of many plants. 9. The elimination of the error in volumetric researches caused by the condensation of the gases on the surfaces of the vessels employed. 10. The determination of the temperature of deep still water, such as lakes, at different depths from the surface. 11. A minute description, from new experiments, of the fecundation in as large a number of plants as possible belonging to the family of grasses. The Haarlem Society of Sciences have also decided to publish a journal in French containing the memoirs that have been read before the Society. The frequency of publication of the journal will depend on the number of memoirs presented. The editorship is entrusted to the perpetual secretary, Mr. E. H. Von Baumhauer, assisted by several Dutch *savans*.

To Keep Eggs.—M. Bournouf recommends in *Le Belier*, a French journal of agriculture, the following method of preserving eggs:—Dissolve in two-thirds of warm olive oil one-third of bee's-wax, and cover each egg completely with a thin layer of this pomade with the end of the finger. The egg-shell by degrees absorbs the oil, and each of its pores becomes filled with the wax, which hermetically seals them. M. Bournouf affirms that he has eaten eggs kept two years in this manner, in a place not exposed to too great extremes of temperature. He thinks also that the germ may in this manner be preserved for a considerable time.

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. *Private* letters for the Editor must be so marked.

Vol. XI. of the Chemical News, containing a copious Index, is now ready, price 11s. 0d., by post, 11s. 6d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. XII. commenced on July 7, 1865, and will be complete in 26 numbers.

Received.—Wm. Huskisson, Jun.

J. W.—Shall receive an answer by post.

Q.—We will make inquiries.

E. W. P.—The process is patented, and the time for publication has not yet arrived. We expect it to greatly increase the yield of precious metals.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On a Process of Fractional Condensation, applicable to the Separation of Bodies having small Differences between their Boiling Points, by C. M. Warren.

It is well known that the process in general use for the proximate analysis of mixtures of volatile liquids—viz., that of simple fractional distillation, either from a tubulated retort or from a flask with bulbs, as proposed by Wurtz[*]—affords but very imperfect and unsatisfactory results, and not unfrequently leads to gross errors and misconceptions, except in those cases in which the boiling points of the constituents are widely different, or in which some auxiliary method can be advantageously employed.

The want of a more efficient process for effecting such separations has long been recognised. There are numerous natural and artificial products of the highest scientific interest—such as petroleums, essential oils, tars, and other mixtures of oils obtained by the distillation, under varied circumstances, of bituminous, vegetable, and animal substances—of which it may at least be said that we have but very imperfect knowledge—I might almost say no knowledge, except such as could be derived from the study of very impure materials—still mixtures of different bodies—with which, instead of the pure substances sought for, chemists have felt compelled to content themselves, as the best results which they were able to obtain by the means at their command.

In repeated instances, apparently after persevering and protracted efforts, investigators have been forced to assert either the impossibility or their inability to obtain from such mixtures bodies of constant boiling point—a property which is generally received as a test of purity for liquid bodies.

I may here specify a few recent instances of this kind.

1\. Warren de la Rue and Hugo Müller,[†] in their paper entitled "Chemical Examination of Burmese Naphtha or Rangoon Tar," after detailing the preliminary treatment by distillation in a current of steam, add that "A further separation of the various products was effected by repeated fractional distillations, but no absolutely constant boiling points could be obtained, notwithstanding the great number of distillations and the large quantity of material at command. It is true that considerable portions of distillates could be collected between certain ranges of temperature, tending to indicate a constant boiling point; nevertheless, it soon became evident that distillation alone could not effect the separations of the various constituents, and that recourse must be had to other processes." The other processes resorted to were treatment with sulphuric and nitric acids, either separately or mixed; but still with very imperfect results. This acid treatment, which was first proposed by De la Rue, and subsequently employed by C. Greville Williams,[‡] Schorlemmer, and others, will be further noticed below.

2\. Frankland,[§] in speaking of a mixture of the hydrocarbons of the formulæ C_nH_n and C_nH_n+1 (now generally considered as C_nH_n+2), which have a difference of 6° to 7° C. between their boiling points, says, "The separation of two such bodies by distillation alone is impossible," and suggests that the employment of anhydrous sulphuric acid may accomplish the object by dissolving out the body of the formula C_nH_n.

3\. And so recently as 1862, Schorlemmer,[||] in his first paper "On the Hydrides of the Alcohol Radicals existing in the Products of the Destructive Distillation of Cannel Coal," remarks that "it was, however, found impossible to obtain a product of constant boiling point by repeated fractional distillations," and he also had recourse to the acid treatment above referred to.

4\. Pebal,[¶] after an elaborate research on the petroleum from Galicia, in which Wurtz's bulbs were employed, and also Eisenstuck,[**] who made an extended investigation of the petroleum from Sehnde, near Hanover, also with the use of Wurtz's bulbs, both assert in the most positive manner the impossibility of separating from petroleum by fractional distillation products of constant boiling point.

Such is the general character of the results obtained in the attempts which have been made to separate the constituents of such mixtures by fractional distillation.

The treatment with strong acids, &c., as an auxiliary to the common method of fractional distillation, which is claimed to have given good results in some cases, is open to serious objections in its application to mixtures of unknown substances, as must be readily apparent. The further consideration of this subject is reserved for another occasion, when I shall submit the results which I have obtained by my process in the study of mixtures almost identical with some of those in the investigation of which the acid process has been employed. I shall then be able to show that the results obtained by that process are, to a considerable extent, inaccurate and by no means exhaustive, and that it is still of the highest importance to have a process which shall be generally applicable in all such cases, without resort to any harsh and uncertain treatment.

With regard to the value of constancy of boiling point above referred to, as a test of purity of a liquid substance, I may here say that, without scarcely lessening the importance of obtaining constancy of boiling point, before resorting to harsher treatment, in the study of mixtures of unknown substances, I think I shall be able to show on another occasion that this property is not necessarily indicative of so high a degree of purity as has generally been supposed, and that a body may have a constant boiling point, and yet contain enough of a foreign substance to appreciably—and in delicate cases seriously—affect the determination of its constitution and of some of its other properties. But in no such case have I yet found that the removal of the impurity by chemical means has essentially changed the boiling point—*i.e.*, never to the extent of 1° C. of temperature. I propose at a future time to study this question synthetically, operating with pure liquid substances, with the view to determine in a few cases how much of a foreign substance may be present—which would probably be variable in different cases—without sensibly affecting the boiling point. A solution of this question would, I

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[*] *Annales de Chimie et de Physique*, 3e Série, xlii. 132.

[†] *Proceedings* of the Royal Society, viii. 221.

[‡] *Philosophical Transactions*, 1857, 447.

[§] *Quarterly Journal* of the Chemical Society, 1851, 3, 43.

[||] *Journal* of the Chemical Society, xv. 419.

[¶] *Annalen der Chemie und Pharmacie*, cxv. 20, asserts the "Unmöglichkeit, das Gemenge durch fractionirte Destillationen zu entwirren."

[**] *Annalen der Chemie und Pharmacie*, cxiii. 169, says as follows:—"Mit den 5° zu 5° aufgesammelten Destillaten wurde die fractionirte Destillation wieder von Neuem vorgenommen, aber nachdem diese Operation sieben Wochen mit etwas 50 Pfund Steinöl fortgesetzt worden war, erhielt ich doch kein Product von irgend constantem Siedepunkt. Nach diesen Versuchen halte ich es für Unmöglich, das Steinol durch fractionirte Destillationen allein in Producte mit constantem Siedepunkt, zu scheiden."

think, be of considerable practical value in some instances.[††]

(To be continued.)

Artificial Crystallisation of Mineral Matters and Metals in the Moist Way,[‡‡] *by M.* FRED. KUHLMANN.

IN former communications I have endeavoured to show that the molecules of bodies, although produced in an amorphous state or in microscopic crystals, may under the influence of constant moisture and rest draw close together and unite so as to take the form of large crystals. This tendency in bodies to assume the crystalline state is very strong, especially when they are in some measure in a growing state; either they become solid by the concentration of the liquids in which they are held in solution, or they assume that condition after the chemical reactions during which they are formed. We know that in the latter case, if the reaction be sudden, the solid bodies generally separate in the amorphous state in the form of a precipitate; if the reaction be slow, they crystallise. In some researches in 1856, I showed that very beautiful crystallisations may be obtained artificially by making two liquids, separated by a diaphragm of porous earthenware, react one upon the other, or by interposing a slight layer of any porous body, such as asbestos or a very thin disc of cork; and finally I showed that, if the two reacting liquids be of different density, it suffices to place them carefully one above the other in order that the precipitate, produced at the instant of contact, should itself form a porous coating through which the reactions may continue. Under these circumstances a change takes place between the elementary principles of the reacting liquids, and the results of the reaction, which become solid, take the crystalline form. It is thus especially that, with hydrochloric acid and acetate of lead, I obtained magnificent crystals of chloride of lead.

I have since ascertained that the reactions in question may be more easily obtained by using one of the reacting bodies in the crystalline state. Thus, by immersing crystals of carbonate of soda in a solution of sulphate of copper, a coating of precipitated carbonate of copper is first produced on the surface of the carbonate of soda crystal, which gradually consolidates, taking the external form of the carbonate of soda crystal. Soon, the reaction between the salts gradually continuing, the whole mass of the carbonate of soda successively disappears and changes into sulphate of soda, the solution of which substitutes itself for that of the sulphate of copper. The carbonated copper slowly produced lines the interior of the covering with amorphous carbonate, thus forming a true artificial geode. By this process I obtained crystals of two modifications of hydrated carbonate of copper—one blue, the other green. These crystals correspond in colour with the azure stone and the malachite, but they appear to contain more water than these natural products.

A crystal of carbonate of soda plunged in a solution of sulphate of nickel gave a geode formed of blue amorphous carbonate of nickel covered in the interior of the crystals with blue carbonate and emerald green carbonate.

A crystal of carbonate of soda plunged in a solution of nitrate of cobalt gave a geode covered in the interior of the beautiful crystals with a ruby-coloured carbonate of cobalt.

Most of the reactions which form bodies susceptible of crystallisation give under these circumstances analogous results. Thus I obtained with crystallised acetate of copper and a solution of silicate of potash a silicate of copper, green, fibrous, and of smooth appearance. The crystals of one of the reacting bodies, if they be anhydrous, are often transformed by *epigenesis*.

In the same manner native carbonate of lead becomes sulphide [illegible] lead when plunged in a solution of sulphide of potassium, still preserving the form of a carbonate. Similarly nitrate of silver becomes transformed into sulphide and into chloride of silver by the prolonged contact of the crystals of the nitrate with a solution of sulphide of potassium or with hydrochloric acid.

It also happens that the body which is sufficiently slowly produced takes the appearance of compact and mammellated masses, which in the natural state represent gummy lead and horny chloride of silver.

I have produced this latter compound artificially by placing a porous body between a solution of nitrate of silver in a flask, and a bath of hydrochloric acid. The chloride of silver, after having produced a porous coating at the point of contact of the two liquids, gave rise to a very remarkable arborisation of compact chloride of silver, similar to horn silver. If we consider on the one hand that naturally chloride of silver often accompanies native silver, and, on the other hand, the facility with which nascent hydrogen reduces chloride of silver, we are led to attribute to the pre-existence of a chloride and to its reduction, the formation of a portion of the native silver.

The force which by simple vibrations causes metals to assume the crystalline form can only be developed under the influence of water, and of acids exercising an energetic influence upon them, and this force is chiefly manifested when exerted on alloys, whether it causes changes in the relation of their constituent elements, or whether it merely produces a modification in their physical state. The following fact supports this opinion:—In the construction of a small lead chamber for the manufacture of sulphuric acid, I had employed for one of the side walls some lead which had been melted down, and which contained 1·60 per cent. of tin, proceeding from the solder remaining attached to the re-melted lead. This chamber was the first of a series of six chambers, and received in a continuous stream the nitric acid destined to react on the sulphurous vapour. Now, after four years of use, whilst the pure lead which had been used for the construction of the other side was found almost intact, the lead charged with tin was much corroded wherever it had been in contact with the vapours, and independently of its having thus become thinner, the lead was very brittle and crystallised throughout.

Analysis, which first fixed the quantity of tin at 1·60 per cent., showed, after the alteration, 1·90 per cent.

Thus, the crystallisation of lead so alloyed has been determined by the action of water and of acids, and the presence of the tin must have been a determining cause of this molecular arrangement and rapid alteration.

The publication of this fact will, I consider, be interesting to manufacturers, especially after the recently announced opinion that lead, when slightly alloyed with some other metals, better resists the action of acids.

The following are some remarkable examples of the crystallisation of metals and of metalloids in the moist way:—

I some time ago found that sulphide of arsenic dissolved in ammonia, left, after some months of contact, a

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[††] Since this was prepared for the press I notice that late experiments by Berthelot go to show the correctness of my conception of the value of constancy of boiling point, as above stated.

[‡‡] *Comptes Rendus*, t. lx., p. 1115.

deposit of arsenic, with its crystalline appearance and metallic brilliancy. There was thus deoxidation of part of the metalloid to form sulphate or arseniate of ammonia.

By immersing a crystal of sulphate of copper in a solution of polysulphide of potassium, the crystal soon becomes enveloped in a covering of sulphide of copper, on which most beautiful crystals of the rhomboidal form arrange themselves.

By immersing crystals of the protochloride of mercury Hg_2Cl, obtained by sublimation, in a solution of monosulphide of potassium, the chloride in a few days becomes transformed into crystallised cinnabar of a beautiful garnet red colour, and half the mercury is displaced. The instability of sub-sulphide of mercury Hg_2Cl explains this.

I have obtained gold in beautiful crystalline spangles by placing some chloride of gold contained in a porous vessel in the midst of a solution of protoxide of iron, of hyposulphite of soda, or of oxalic acid.

Lastly, I give an example of metallic crystallisation by the wet way, certainly more curious than any of the preceding examples.

I placed a large crystal of sulphate of copper in a solution of monosulphide of potassium, and allowed all to stand for ten days. At the end of that time the outer surface of the crystal of sulphate was transformed into sulphide, and presented the exact external configuration of the primitive crystal.

On breaking the crystal thus modified, I found that the thick covering of sulphide of copper presented on the surface of its inner wall, a well-determined crystalline appearance, and that above this crystalline covering of sulphide a mass of metallic copper had been formed, varying in thickness, and crystallised into beautiful octahedra. In the centre of the crystal was sulphate of copper, still intact, but between the sulphate and the metallic copper a considerable quantity of double salt of sulphate of copper and potash was formed. It was a clear blue hydrated salt, crystallised in cubes. I found on analysis that its composition may be represented by this formula—$KO,CuO,{}^2SO_3 + 6HO$.

The explanation of the formation of sulphide of copper from this double sulphate is not difficult, but this cannot be said of the formation of metallic copper.

However, this unexpected production seems to me to be accounted for in the following manner:—We know how easily salts of copper are generally reduced, and that the prolonged contact of some organic matter is sufficient to bring about that reduction. Thus in ink, for example, there is often a deposit of microscopic crystals of copper, when sulphate of copper and a decoction of logwood were used in the manufacture. We also know that sugar effects this reduction with extreme facility; and, again, a stick of phosphorus left in a solution of sulphate of copper becomes, in a short time, enveloped in crystallised copper.

Lately, whilst going over the excellent mineral works of MM. Perret, of Lyons, I learnt a very interesting fact from those manufacturers—namely, that on emptying an old cistern which had for some time been filled with water charged with sulphates of copper and iron, moderately thick coverings of metallic copper were found attached to the wood which had served to support the roof of the cistern, and amongst the stones forming its floor. MM. Perret gave me some specimens they had collected, which presented clusters formed of a collection of octohedral and very large crystals.

The *débris* of the wood had doubtless acted by reduction on the cuprous solution. The reducing gases developed in the cistern had also acted.§§

I have also mentioned this deoxidising property of wood when in contact with sesquioxide of iron, in a work on the changes effected in the planking of ships by the nails and iron bolts. We also know that in stagnant waters, sulphate of iron is easily transformed into sulphide, and that crystalline clusters of pyrites often attach themselves to tufts of water reeds. There was an account in the German papers of a traveller who was lost in a mine, drowned in waters charged with sulphate of iron; after the lapse of some years the body was found coated with crystallised sulphide of iron, caused by the length of time it had lain in the ferruginous solution.

As to the formation of metallic copper by the action of sulphide of potassium on a crystal of sulphate of copper, it seems to me likely that that which can produce reducing bodies instantly on contact can also be produced through a porous covering of sulphide of copper by the deoxidising action of sulphide of potassium and of hyposulphite of potash with which this sulphide is charged, when its solution is for some time exposed to contact with the air.

I believe, then, that the formation of these crystals of copper must be attributed to a cause analogous to that which produces silvering and gilding by the wet way by means of reducing bodies; and finally to the reactions which organic matter exerts upon salts of copper and iron, and which cause the formation of native copper and iron pyrites.

The Analysis of Waters.

It is well known that chemists are at variance as to the best method of calculating the weighed results of waters. The many discrepancies which occur in the analysis of such by different chemists are no doubt due to the existing difference of opinion as to the states of combination of the various salts held in solution. A process which I have for some time worked gives most satisfactory results, and shows beyond doubt the true composition of the saline matters.

An ordinary potable water generally contains the chlorides of calcium, magnesium, potassium, and sodium (the chloride of calcium in extremely minute proportion). The sulphates of these alkaline earths and alkalies, with carbonate of iron, lime, magnesia, and silica.

One gallon or so of the water is brought to complete dryness at 212° F., lixiviated several times with boiling absolute alcohol, filtered, and washed with hot alcohol. This may be marked "alcoholic solution," and contains the chlorides only of calcium, magnesium, potassium, and sodium. This filtrate is boiled with water until all the spirit is driven off, and the chlorine and bases ascertained in three different portions. These results are calculated into chlorides; the chlorine serves as a check.

The residue insoluble in the alcohol is gently dried, boiled several times with water, filtered, the filtrate divided into three parts, and the lime, magnesia, potash, and soda, with the sulphuric acid, determined. Calculated into sulphates, the sulphuric acid as check.

The part insoluble in the water contains sulphate of lime (much of which has not been dissolved by the water), carbonate of lime, magnesia, peroxide of iron, and silica. It is dissolved in dilute hydrochloric acid,

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§§ M. Clement Desormes had already proved that in the manufacture of crystallised sulphate of copper he could produce crystals of copper in the sides of wooden tubs.

the silica filtered off, the filtrate divided into two parts, and the sulphuric acid found in one, the iron, lime, and magnesia in the other. The sulphuric acid is calculated into sulphate of lime, and the excess of lime found into the carbonate; the iron and magnesia into carbonate. (The sulphate of lime found in the water solution is to be added to the sulphate got at this stage.)

The escape of chlorine from the chloride of magnesium on evaporation of the water to dryness I have ascertained to be most minute, so that any objection on this score is removed, since it seems the large quantity of alkaline chlorides always present prevent this.

The total residue, organic matter, and silica should be determined in another portion of the water. In the evaporation of the water for analysis a large beaker or basin is preferred.

The advantages of this process are the solubility of the chlorides alone in alcohol, the solution of the sulphates in water, and the carbonates, &c., in the acid.

R. C. M.

Edinburgh, August 21.

PHARMACY, TOXICOLOGY, &c.

On Tobacco, by FERDINAND F. MAYER, *of New York.*

(*Continued from page* 75.)

Examination of Tobacco.—The material engaged for the experiments with fresh tobacco,—a dozen plants in full growth, collected after "topping" the buds,—unfortunately, by some delay in delivering, reached me in so damaged a condition as to reduce very considerably the extent of my investigations.

Of the uninjured leaves, with their petioles and ribs, 25 troy ounces were spread out to dry until their weight had been reduced to 1625 grains,—a loss of 86·5 per cent., though they were not yet perfectly air-dry.

Of this weight, only 245 grains had remained green throughout, or showed scarcely any decolorisation. The remainder had become more or less brown, on the upper surface principally, scarcely on the lower. They possessed a simple herbaceous odour, no pungency like that of ammonia, or commercial leaf, but a decidedly acrid taste.

One hundred and seventy-one grains of the green leaves were exhausted with boiling alcohol—dilute alcohol acidulated with hydrochloric acid—and the alcohol removed from the tincture by distillation. The residue indicated, when tested with tenth normal solution of iodohydrargyrate of potassium (one cubic centimetre = 0·0045 of a gramme = 0·0625 of a grain of nicotina), 2·345 grains of the alkaloid in 171 grains. 1·36 per cent. of the dry leaf = 0·1836 per cent. in the fresh.

Six hundred and sixty grains of the leaves which had become somewhat tainted were treated in precisely the same manner. They indicated within a mere fraction of 9·37 grains of alkaloid, = 1·42 per cent. in the dry, = 0·1917 per cent. in the fresh state.

Of the fresh leaves, the juice of which was of a very decided acid reaction, 28·5 troy ounces had at the same time been placed in digestion at a moderate temperature for several days with water acidulated with sulphuric acid. The 3700 cc. of liquor resulting, contained, according to assay, 28·87 grains of nicotina, equal to 0·21 per cent. in the fresh state.

Ten troy ounces of the same were macerated in the same manner; the resulting liquor, however, evaporated in a porcelain dish to the consistence of soft extract, and after redissolving tested with iodohydrargyrate; this indicated 4·75 grains; only 0·1 per cent. were still present.

Commercial tobacco, known as Connecticut seed-leaf, and reported to be of the same variety and neighbourhood as the fresh plants under examination, presented the usual properties of good tobacco. Its simple watery infusion was decidedly alkaline. Hydrogen gas and still more air at slightly elevated temperature passed over the tobacco contained in a long tube, carried off very noticeable quantities of nicotina and ammonia. On distilling it with water, the vapours carried over nicoammonia, and its carbonate, and it was observed that the whole of the nicotina contained in a watery infusion could be evolved by boiling, or distilling it with a large excess of caustic ammonia.

As the result of several assays with two troy ounces at each time, I obtained as mean proportion of nicotina 13·25 grains, equal to 1·36 per cent. of the leaf, precisely the percentage in the first assay as given above.

Tobacco seed of the same variety possesses scarcely any acridity, except what arises from rancidity of the oil. The latter is at times extracted as from other seeds, and employed for household use. Decoction with acidulated water was found to be the best mode for their extraction.

Three troy ounces, thoroughly bruised, were boiled for several hours with water and a little sulphuric acid. The filtered liquor indicated, with iodohydrargyrate, 6·46 grains of nicotina = 0·45 per cent. of the seed.

The leafstalks and ribs of the commercial leaf, and the liber of the green stalk, yielded noticeable quantities of the alkaloid, but their percentage was not determined.

For the purpose of identifying the alkaloid, or bases carried down by iodide of mercury from acidulated solutions in these several instances, the precipitates were washed with water—(since the test solution of iodohydrargyrate, besides containing a large excess of iodide of potassium, is too dilute to allow any trimethylina to be precipitated, no attention needed to be paid to any possible decomposition of the precipitate); it was then rubbed smooth in a mortar with a concentrated solution of protochloride of tin, to which were afterwards added small pieces of caustic potassa, so as to form an alkaline solution of protoxide of tin. The result in this, as well as in the case of all other bases, when their compounds with mercury are similarly treated, is that the mercury is reduced to the metallic state, its iodine or chlorine combining with the tin: the hydriodate of the base, then disengaged, is acted on by the excess of caustic alkali, and the base, when the mixture is now agitated with ether, is at once taken up in an almost pure condition.

After distilling off the ether, the residue is dissolved in dilute hydrochloric or oxalic acid, filtered, again shaken with alkali and ether or chloroform, which will then give a pure solution of the base, provided no lengthy evaporation has been made use of, in preparing liquors for precipitation with mercury.

The ethereal solution obtained in this manner from precipitates of nicotina at first leaves the alkaloid as a pale, yellowish, oily liquid surrounded by a greenish brown soft resin or impure wax, which, next to ammonia, is the cause of the pungent odour of tobacco. To a certain extent it is a product of the oxidation of the alkaloid, but when repeatedly dissolved in alcohol it is odourless and tasteless, and contains no nitrogen.

Pure nicotina obtained from the second or third solution in ether is colourless, has no odour at first, but acquires the pungency and odour of tobacco after some hours' exposure to the air, or on being heated. It agrees in most respects with the description given by Henry and Boutron-Charlard. Half a drop of it instantly killed a full-grown pigeon.

The liquids from which the precipitate of nicotina with mercury had been obtained, and which contained an excess of iodide, were, after filtering, rendered alkaline by the addition of caustic potassa. This causes a decided precipitate only in the case of commercial tobacco; the solutions from the dried leaves, in both the above experiments, gave a faint cloudiness. The filtrate from the seeds did not even show a trace of what would have indicated the presence of ammonia.

The precipitate produced in the first case was decomposed by alkali and protoxide of tin and then distilled; the distillate was converted into a platinum salt, which had all the properties of that of ammonia.

Having become satisfied, by my preliminary examination, that no stronger alkali than ammonia was required to expel nicotina as well as trimethylina, parts of the solutions to which no mercury had been added were severally distilled with caustic ammonia.

In the case of the acid infusion of fresh tobacco, no bases besides ammonia (from the retort) and nicotina were to be found in the gases and the liquids which came over and were received in hydrochloric acid. Evaporated to dryness, and tested for trimethylina, no traces of it could be discovered by the reactions described above, nor any particular resemblance in the odour; nor could any inflammable gas be extracted from the residual chlorides on heating with caustic potassa or baryta.

With an infusion of commercial tobacco, a great part of the nicotina comes over without the addition of an alkali, and nearly the whole quantity is obtained by adding a considerable excess of ammonia. This form is likewise free from trimethylina.

There is no perceptible difference in this respect between a decoction of the seed, and one of the fresh plant. The distillate contains only ammonia [intentionally] and nicotina.

From the watery distillate of ordinary tobacco, which had a milky appearance, but gave no deposit, and contained both ammonia and nicotina in solution, after acidulating with sulphuric acid, ether extracted a small quantity of a substance which I believe to be identical with the soft resin described before.

Though the experiments delineated so far are evidently yet incomplete, they still serve to answer the question proposed as completely as was possible at this season of the year.

The conclusions which I beg to submit are,—

1. That nicotina is the active principle in all parts of the plant before and after curing.

2. That there is in all probability no increase, but rather a loss of nicotina during the drying and curing, partly or wholly caused by volatilisation; and

3. That the plant or its parts contain no trimethylina, nor any ammonia while fresh.—*Proc. Amer. Pharm. Asso.*, 1865.

Paris Exhibition of 1867.—A Report by M. Dumas to the Imperial Commission on the size and plan of the building necessary for the Exhibition is published in the *Moniteur Scientifique*. It states that at least 30,000 exhibitors may be expected to contribute, and space must be found for that number. The names of the French jurors in the division of agricultural products and manufactures have also been published, and we observe in one division or another the name of almost every chemist of note in Paris.

PROCEEDINGS OF SOCIETIES.

COLLEGE OF PHYSICIANS.

"*On Animal Chemistry.*" A course of Six Lectures by
William Odling, M.B., F.R.S., F.R.C.P.

Friday, May 5, 1865.

Lecture 4.

Eternal relations of vegetable and animal processes—Nature of cosmical forces—Neutral convertibility of heat and motion—Their quantitative equivalency with one another—Illustrations of motion resulting from muscular effort—Force rendered latent in mechanical separation of attracting bodies—Actual and potential energy—Chemical separation of attracting bodies—Theory of electrolysis—Force of galvanic battery derived from combustion of zinc—Heat of dissolving zinc manifested externally in ignition of platinum wire—The same heat stored up in electrolytic oxygen and hydrogen—Its reproduction by explosion of mixed gases—Solar heat rendered latent in separated oxygen and vegetable tissue—Its liberation by combustion of vegetable tissue in air—All terrestrial force traceable to the sun—Accumulation of solar force by vegetable organisms—Its dissipation by animal organisms—Reverse subsidiary actions—Baseless hypothesis of vital force—Artificial performance of alleged vital syntheses—Stages of constructive vegetal and destructive animal action—Occurrence of same intermediate products in both kingdoms—General processes of synthetic chemistry—Passage from one organic group to next in complexity—Continuous series of synthetic operations—Production of urea, formic acid, prussic acid, methylamine, and chloroform from mineral elements—Synthesis of di-carbon compounds, including alcohol, triethylamine, taurine, acetic acid, glycocine, and oxalic acid—Of tri-, tetra-, and penta-compounds, including glycerine, the lactic, butyric, succinic, malic, tartaric, and valeric acids, and fousel oil—Of hexa-compounds, including caproic acid, leucine, and grape sugar (?)—Of hepta-compounds, including oil of bitter almonds, and the benzoic, salicic, and gallic acids—Possible artificial manufacture of food.

At the conclusion of my last lecture I was insisting upon the importance of considering the phenomena of animal and vegetable life in relation to the external forces of the universe. I observed that, however valuable might be the study of the more minute and elementary forms of life, and I was far from wishing to decry its value in any way, there were some great truths, on the other hand, which could only be appreciated by comparing the most highly differentiated forms of life with one another, not in their minute details, but in their broad general features. I observed, further, that while the chief cosmical function of highly developed vegetable life was deoxidation, or the separation of oxygen from carbon and hydrogen, the leading function of highly developed animal life was oxidation—the recombination of the separated oxygen and carbo-hydrogen with one another; and we agreed to investigate upon this occasion the essential nature of these two correlative processes. I said, further, that I was induced to bring this subject under your notice in a more elementary and detailed manner than I originally contemplated, from finding that certain principles admitted by physicists to be as fundamental as the laws of gravitation were not heartily and unreservedly acknowledged by physicians.

First of all, then, we have to consider what is the character and import of that deoxidation of carbonic anhydride and water, which takes place in vegetable organisms; and by the exercise of what forces is it brought about. Now, in entering upon the discussion of this question, I must direct your attention for a short time to topics which at first sight seem but very remotely connected either with chemistry or physiology. To paraphrase in sober earnest the expressions used in sarcasm by a very distinguished Fellow of this College, the value of whose contributions to physiological science no one can be more ready than myself to acknowledge, I shall preface my remarks by a few observations upon force and the constancy of its amount in the universe. Then, by a reference to systems and suns, and worlds, and steam-engines, and mills, and telegraphs, I shall endeavour to satisfy you that the same forces are at work in living plants and animals as in the inorganic world; and that the study of the indestructibility and correlation of force will teach us much, though very far from all, concerning the nature of life.

Let us begin, then, by considering the correlation that exists between the forces of heat and motion—their equivalency with, and convertibility into, one another—of which no better illustration perhaps can be chosen than a steam-engine; and the philosophical toy upon the table known as Hero's œlipile will answer our purpose perfectly well. On lighting a fire under the boiler of a steam-engine, some of the heat liberated in the furnace gradually passes into the water; and as each successive increment of heat is transmitted from the furnace into the water, the temperature of the water rises until it arrives at a certain point. During the time the water takes in rising from its original temperature up to the boiling point, heat is being conveyed into it, at what may be regarded as an uniform rate. When, however, a certain degree of heat is reached, the temperature of the water no longer rises, although the heat of the furnace continues passing into it at the same rate as before; but now some of the heat absorbed, instead of being manifested in the form of heat, appears in the form of motion, and the steam-engine is set to work. Just as in the œlipile before you, the heat of the spirit lamp was passing into the water for several minutes with no other effect than that of raising the temperature of the water; whereas, after the lapse of several minutes, the heat of the spirit lamp continually passing into the water ceased to increase the temperature of the water in the slightest degree, but caused, instead, a rapid rotatory motion of the instrument. Thus, we perceive generally that the development of motion is consequent upon an absorption of heat, and conversely, we shall find that an arrest of motion is tantamount to the liberation of heat. For example, if we employ our steam power in drilling a piece of metal, the motion of the engine is lessened by the friction of the drill, and a certain amount of heat is thereby generated. The original heat of the furnace, absorbed by the boiling water without any increase of temperature, produces a less amount of motion than formerly, but the diminution of motion is supplemented by an increase of heat—less of the heat which passes into the water being now manifested in the form of motion, but the difference reappearing at a distance in its primitive form of heat.

Similarly when a bullet strikes upon an iron target its motion is suddenly arrested, and its temperature as suddenly raised. That which was motion has become heat, and the quantity of heat shared between the bullet and the target is exactly proportional to the previous velocity of the bullet, or to the quantity of its motion that has been arrested. Again, in exact proportion to the diminution of motion in the working parts of the engine, so is the amount of heat developed by the friction of the drill upon the piece of metal. For not only are heat and motion convertible into one another in a general way, but they are convertible in a manner which admits of accurate measurement. By suitably contrived experiments it may be shown, in every instance, that so much heat developed is equivalent to so much motion arrested, and conversely that so much motion generated is equivalent to so much heat absorbed. It has been ascertained for instance, more particularly by Mr. Joule, that the force of a pound weight falling through 772 feet is exactly equal to the amount of heat which a pound of water will give out in cooling one degree Fahrenheit; or, in other words, that the heat developed by the arrest of the motion of a pound weight falling through 772 feet would raise the temperature of a pound of water one degree, and that the heat given out by the cooling of a pound of water one degree would lift a pound weight through the height of 772 feet. Heat and motion, therefore, are in every case interchangeable for one another according to a definite standard of equivalency.

Now, let me direct your attention to some simple illustrations of motion; and, first of all, to the direct motion of a projectile hurled from the arm of a man. Upon seeing the rapid flight of a dart or javelin through the air, we recognise immediately that the motion of the javelin did not originate in itself, but was impressed upon it by some external force. We never think of attributing its motion to the exercise of any internal javelin force, but to the action of the muscular force by which it was originally projected. We know that the momentum of the javelin is exactly proportionate to the amount of force exerted in hurling it, and that when it strikes some distant object, the blow which that object receives is as surely struck by the man as if he had delivered it directly with his fist. Let us now take an illustration, in which motion is transmitted through the intervention of some simple instrument, as in the case of a bow and arrow, for example. Here, also, the motion of the arrow through the air does not take place in virtue of any force originating in the bow, but is consequent on the muscular force exerted in drawing the bow and cord asunder; and, limited only by the susceptibility of the bow, the momentum of the arrow depends entirely upon the amount of force exerted by the archer in pulling the bow-string.

Again, in discharging a cross-bow, the cord is first drawn over the catch by a muscular effort, and the arrow afterwards projected by the release of the cord. Although the susceptibility of this kind of bow is far more limited than that of a long bow, still it is evident that the force with which the arrow is eventually projected does not originate in the bow, but is only a transformation of the muscular force exerted in separating the cord and bow from one another. Now, suppose that, instead of pulling the trigger of the cross-bow immediately after the cord has been drawn over the catch, we allow the bow to remain in its stretched state for weeks, or months, or years, and then release the cord; still the force with which the arrow is eventually projected will be the original muscular force exerted at the moment of pulling the bow and cord asunder. Suppose, for instance, that I were to draw the cord of a cross-bow over the catch to-day, and a century hence some one were to release it by touching the trigger, still the force of the projected arrow would not be his force, but my force, exerted by me to-day, lodged in the bow for a hundred years, then manifested in the motion of the arrow, and finally transformed into heat upon the cessation of its flight.

Similarly the force with which a cannon-ball falling from the top of the Monument would strike the pavement below, would be the exact expression of the force exerted in lifting it to the top—that is to say, in separating the cannon-ball and the pavement a certain distance from each other, no matter how many years before. We may thus render muscular force latent in the stretched bowstring, raised cannon-ball, or other instrument, for any length of time. This latent force is generally spoken of as potential energy, while the active force exertable at any moment by the flying arrow or falling ball constitutes its actual or dynamic energy. Thus the actual energy of my arm becomes the potential energy of the crossbow, reappears as the actual energy of the projectile, and is finally not lost, but dissipated in the form of heat. The point, then, I wish particularly to impress upon you is that the actual mechanical energy manifested in the falling together, or springing together, of two separated bodies, the ball and the earth, the cord and the bow, is only a liberation of the potential energy stored up in them at the moment they were pulled apart from one another.

Let us now turn our attention to an altogether different kind of pulling apart, namely, the pulling apart of oxygen and hydrogen from their state of chemical combination. I am here repeating the well-known experiment of the electrolytic decomposition of water. By means of a galvanic battery I am tearing asunder the previously combined oxygen and hydrogen, and collecting the two gases in separate cylinders. Now, what is the nature of this separation, and how is it brought about? Seizing one link in the chain of actions as a starting-point, let us consider first of all the combination of zinc in the battery-cell; for in all ordinary batteries the direct or indirect oxidation of zinc is the source of the power obtained. Upon holding this bundle of loose zinc shavings in the blowpipe flame, you observe that the metal takes fire from time to time and burns with very great brilliancy, being converted into the white flocculi of oxide of zinc which are now floating about the room. If we introduce the ignited zinc into a vessel of chlorine, it continues to burn, you perceive, with even greater intensity than before, producing abundant fumes of chloride of zinc. But we may obtain chloride of zinc more readily by dissolving the metal in hydrochloric acid, and in this case, also, the combination of zinc with chlorine is attended by an evolution of heat. Thus, the solution of granulated zinc in hydrochloric acid, now taking place in this gas generating flask, is being accompanied by a considerable elevation of temperature in the liquid, as well as by an evolution of hydrogen, according to the equation—

$$\overset{\text{Zinc.}}{Zn''} \quad + \quad \overset{\text{Hydrochloric acid.}}{2HCl} \quad = \quad \overset{\text{Zinc chloride.}}{Zn''Cl_2} \quad + \quad \overset{\text{Hydrogen.}}{H_2}.$$

Now, equivalent for equivalent, the quantity of heat liberated by the combination of zinc with oxygen or chlorine is much greater than that evolved by the similar combination of hydrogen; and, accordingly, when we burn zinc at the expense of hydrogen, as in this experiment, we obtain in the flask only so much of the heat produced by the burning of the zinc as is in excess of the heat absorbed in the unburning, so to speak, of the hydrogen.* Hence, leaving out of consideration certain subsidiary phenomena, the heat produced by the solution of a given quantity of zinc in hydrochloric acid, and the heat producible by burning the thereby liberated hydrogen in an atmosphere of chlorine, added together, would exactly equal the amount of heat producible by burning the same quantity of zinc directly in chlorine gas, as we did a minute or two ago. Thus, by the solution of zinc in hydrochloric or sulphuric acid, we have a certain proportion of the combination-heat of the zinc set free. The intensity of this heat is not great, in consequence of its being associated with so large a mass of matter in the flask, but its quantity is very considerable, and constitutes, indeed, the entire dynamic energy we have at our disposal in the galvanic battery.† When the zinc and platinum plates of the battery communicate freely with each other, the combination-heat of the attacked zinc is manifested solely by a rise of temperature in the contents of the cell, precisely as in the case we have just considered of the simple solution of granulated zinc in hydrochloric acid. But the battery is a machine for enabling us us to apply and transform this combination-heat of the zinc in a variety of ways. For instance, if I complete the communication between the zinc and platinum plates by means of a platinum wire, you observe the small coil of wire assumes an intense state of ignition. Now, the heat of the platinum wire is nothing more than a portion of the translated heat of the zinc burning in the cell; which, instead of being manifested at the point of action in the cell, is manifested at a distance in the platinum wire; much as a portion of the furnace heat absorbed in the evaporation of water may be manifested at a distance by the friction of a drill. The heat exhibited in the platinum wire does not originate in the wire, but in the cell, and so much of the heat of the burning zinc as appears in the wire is lost to the cell. Just as the contracting muscle strikes its blow at a distance of many yards by means of the conducting javelin, so does the burning zinc strike its blow at the spot to which its impulse is conducted by the copper strands.

In electro-motive machines, the heat of the burning zinc is employed in doing mechanical work, just as the heat of burning coal is employed, though with far greater economy, in a steam-engine. But in the decomposition of water taking place upon the table, the heat of the burning zinc is employed in the chemical work of pulling oxygen and hydrogen apart from one another. Of the heat producible by the combustion of a given weight of zinc, the proportion manifested externally in the ignition of platinum wire, or employed externally in the separation of oxygen and hydrogen, is supplemental to the quantity absorbed in heating the cell; so that in the electrolysis of water, as in the heating of platinum wire, so much the more external work done, so much the less internal heat developed. By the electrolytic decomposition of water, the heat of the burning zinc, which does not appear internally in the cell, and which might be manifested externally in the ignition of platinum wire, lies dormant in the separated oxygen and hydrogen; but it is not lost. On the contrary, I can render it manifest to you with the greatest ease. Now that we have collected a sufficient quantity of our electrolytic gases, I have only to mix them together and explode them, when you observe a considerable evolution of light and heat resulting from their combination; which light and heat are nothing more than the light and heat of the burning zinc, not manifested in the cell, but retained for a time in the separated gases, so as to constitute their potential energy. The explosion of the gases at once or a hundred years hence would make no difference. The heat and light resulting from their eventual explosion would still be the heat and light of the burning zinc stored up in them, so to speak, at the moment of their electrolysis. In my last lecture I showed you the formation of water by the combustion of hydrogen in the oxygen of the air, and called your attention specially to the heat developed by the combination. The heat so developed did not originate in the oxygen and hydrogen, but was simply a liberation of the heat force, which, directly or indirectly, at some time or other, had been employed in pulling them apart, and been rendered latent in them so long as they continued apart—just as the force of a stretched crossbow does not originate in the bow, but is merely latent muscular force stored up in the separated bow and cord. Similarly in the rapid combustion of carbon in oxygen gas to form carbonic anhydride, there was no generation of heat, but only a liberation of the heat previously stored up in the two separated elements.

Now, then, we are in a position to understand the nature of the action taking place in the vegetable kingdom, by which carbonic anhydride and water are decomposed—to consider what is the external force employed in the pulling apart of oxygen from hydrogen and carbon, and what becomes of it. This force is no other than the light and heat force emanating from the sun, rendered latent in the oxygen on the one hand, and carbo-hydrogen of vegetable tissue or secretion on the other, and repro-

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* *Vide* Professor Williamson's lecture "On the Dynamics of the Galvanic Battery," *Phil. Mag.*, xxvi., 452.

† Taking as our unit of heat the quantity of heat necessary to raise the temperature of a kilogramme of water 1° C.—that is to say, from 0° C. to 1° C.—it is found that 65 grammes of zinc Zn'', in combining with twice 35·5 grammes of chlorine Cl_2, to form 136 grammes of chloride of zinc $Zn''Cl_2$, evolves 101·31 units of heat; whereas 2 grammes of hydrogen H_2, in combining with twice 35·5 grammes of chlorine Cl_2, to form 73 grammes of hydrochloric acid $2HCl$, evolves only 47·56 units of heat; hence in decomposing 73 grammes of hydrochloric acid by 65 grammes of zinc, according to the equation $Zn'' + 2HCl = Zn''Cl_2 + H_2$, we should have $101{\cdot}31 - 47{\cdot}56 = 53{\cdot}75$ units of heat liberated as initial battery power.

ducible by the act of their recombination or combustion. The sun's rays, for instance, falling upon the leaves of the sugar-beet or sugar-cane effect an eventual decomposition of carbonic acid into oxygen and sugar, thus:—

$$\begin{array}{cccc} \text{Carbonic anhyd.} & \text{Water.} & \text{Sugar.} & \text{Oxygen.} \\ 12\,CO_2 \; + & 11\,H_2O \; = & C_{12}(H_{22}O_{11}) \; + & O_{24}. \end{array}$$

But the heat and light of the sun absorbed in this pulling apart of oxygen and carbon, the one discharged into the atmosphere, the other retained in the vegetable juices, are not lost, but rendered latent in the oxygen and sugar respectively. Here I have a mixture of sugar with a compound in which the oxygen of the air has been accumulated, namely, chlorate of potassium, and on touching the mixture with a drop of sulphuric acid—on pulling the trigger of the cross-bow, so to speak—there is produced a brilliant deflagration, in which the light and heat of the sun, stored up in the separated sugar and oxygen, are again manifested to you by their combination with one another to reproduce carbonic acid. The light and heat of this combustion, and, indeed, of every combustion, are nothing more than the light and heat of the sun, originally absorbed by the living plant, and rendered latent in the tissue of the plant, and oxygen of the air respectively. Even the heat evolved by the direct or indirect combustion of zinc is no exception; it is only the heat stored up in the metal at the moment of its deoxidation by means of the coal or charcoal in which the sun's force was intermediately retained.

We see, then, in this way that the vegetable organism is a machine in which the sun's energy is absorbed in the pulling apart of carbon and hydrogen from oxygen. The light and heat force emanating from the sun is rendered latent in the separated oxygen and carbo-hydrogen, just as human muscular force is rendered latent in the stretched cross-bow. When the separated carbo-hydrogen in the form of some vegetable product is recombined with the evolved oxygen, as in burning a log of wood upon the fire, or in consuming bread and oil and wine in the animal frame, the heat liberated in both instances is nothing more than the heat of the sun which had been stored up in the carbo-hydrate and oxygen respectively. Conversely, the animal frame is a machine in which the sun's energy is set free by the recombination of that oxygen and carbo-hydrate, in the pulling apart of which it had been absorbed or rendered latent. The plant may be regarded as a miser, or hoarder up, the animal, on the other hand, is a spendthrift, or dissipator, of the sun's force; but just as the miser is not a producer, or the spendthrift a destroyer of gold, so neither is the vegetable a producer, nor the animal a destroyer of force. All modern philosophy combines to prove that force, like matter, is indestructible. It may be accumulated, but not created; be dissipated, but not destroyed. The force of every kind, active or latent, existing in the earth, at any given moment, is only the sum of the force received by the earth from the sun in excess of the force radiated by the earth into space.

Hitherto, in contrasting the functions of animal and vegetable life with one another, I have had regard to their broad general features, looking at each description of life as a whole. A more detailed examination, however, shows us that oxidising and deoxidising processes are common to both kingdoms of nature. For instance, the germination of seeds and maturation of fruits are strictly oxidising acts, whilst the conversion of starch or sugar into fat in the animal organism, is a strictly deoxidising or vegetative act. It would seem, indeed, that in all purely nutritive processes, whether of vegetable or animal life, there is an absorption or rendering latent of force, and consequent necessity for its supply. In highly-developed vegetable life this force is derived directly from the sun. In highly-developed animal life it is obtained by a liberation within the body of the sun's force which had been rendered latent in the food we eat and the air we breathe respectively. But whilst nutrition, or the storing up of force, constitutes the chief action of vegetable life, in animal life it occupies an altogether subordinate position. For the prime characteristic of animality is activity, the employment of pent-up force in the production of external acts. Hence, while in the vegetable and animal organism deoxidising and oxidising processes, constructive and destructive actions alike take place, in the vegetable the destructive are subordinate to the constructive, whilst in animals the constructive are subordinate to the destructive acts. The contraction, for instance, of a man's muscle depends entirely upon the oxidation or destruction of the substance of that muscle, and the equivalent of motion produced upon the amount of muscle destroyed.

Thus we perceive that all actions of the animal body are traceable to cosmical force, that in living as in dead matter there is no creation of force, and that any explanation of the phenomena of life which recognises the agency of vital force is simply no explanation at all. Applying the word force as we now do to certain transferable states of actual or potential activity having quantitative metamorphic correlations, I much question whether the expression chemical force is a correct one, though it is one of which the meaning is perfectly definite and intelligible. By the chemical force of so much oxygen and hydrogen, for instance, we mean the potential energy stored up in them at the moment of their separation, and reproducible from them in the act of their combination. Similarly, we might apply the phrase vital force to the potential energy of so much fat or muscle, capable by oxidation of being manifested in the form of external heat or motion. But what the physiologist means by vital force I have never been able to understand. So far as I can make out, it seems to be a sort of internal, incommunicable, immeasurable, self-originating power, which performs nutritive acts by its absolute will and pleasure; as if it were not abundantly manifest that the growth of a plant and incubation of an egg cannot be performed without a direct supply, and the development of animal organisms without an indirect supply of extraneous force. Speaking of the progress of natural science, Mr. Mill has pertinently observed that for a long time "fictitious entities continued to be imagined as means of accounting for the more mysterious phenomena; above all, in physiology, where under great varieties of phrase, mysterious *forces* and *principles* were the explanation, or substitute for explanation, of the phenomena of organised beings."

Seeing, then, that the enormous number and variety of vegetable compounds are produced out of carbonic acid and water, not by any peculiar vital force, but merely by the light and heat force of the sun acting through vegetable machinery, the question naturally arises whether the chemist may not effect in the machinery of his laboratory a similar intercombination of deoxidised carbonic acid and water, either by a direct application of sun-force, or, indirectly, by the aid of those terrestrial transformations of sun-force which are so abundantly at his disposal. This question, decided absolutely in the negative so long as the fiction of vital force held undisputed sway over men's minds, has of late years received a rapid succession of brilliant affirmative replies. Already hundreds of vegetable compounds heretofore produced only in living organisms, and, as was supposed, put together and held together by vital force, have been formed by the chemist in his laboratory out of carbonic acid, water, and ammonia, or, in other words, out of charcoal, hydrogen, oxygen, and nitrogen. That a still greater number of compounds have not been so formed is due more to a deficiency of knowledge than of power; for as our acquaintance with the constitution of bodies, and with synthetic processes, is daily advancing, so is the unlimited constructive power of chemistry becoming daily more and more apparent.

(To be continued.)

ACADEMY OF SCIENCES.

August 14.

M. Pasteur communicated some "*New Observations on the subject of the Preservation of Wines.*" The author's recent communications on this subject are within the memory of our readers; but we may as well give M. Pasteur's recapitulation. He believes that he has established (1) that wine ripens, or, in other words, is improved by age simply by the action of atmospheric oxygen; (2) that when wine becomes what is called sick, it is in consequence of the presence of parasitic vegetation; (3) deposits form in wine either in consequence of oxidation, or from the presence of parasites, or most frequently from the two causes together; (4) the deposits resulting from oxidation adhere, but parasites render wine turbid. Consequently the most important thing for the preservation of wines is to destroy the vitality of the parasitic germs. The author shows that new wine placed in bottles with the air completely excluded gives no deposit, never changes colour, and never acquires a bouquet. On the contrary, the same wine under the influence of atmospheric oxygen becomes muddy, loses the taste of new wine, does change in colour, and acquires a bouquet, and he adds that all these effects of *ageing* may be produced in the interval of a few weeks. The author's process is known to our readers. He destroys the parasitic germs by exposing the wine for a time to a high temperature. He states that it is sufficient to raise the wine for a few minutes to 60° or 70° (C.) to give an extraordinary power of resisting *sickness.* His last experiments seem to show that 45° C. may be sufficient. After exposure, it is said that the wine may be exposed to the air without fear of its becoming acid. As regards the flavour of wine treated by the author's process, he relates that a professional taster who made comparative experiments without knowing which had been submitted to treatment and which had not, gave a preference to the treated wines seven times out of nine.

M. P. Schutzenberger presented a memoir "*On Some Derivatives of Indigotine.*" Indigotine by oxidation gives isatine, which, by the action of nascent hydrogen from zinc and hydrochloric acid, gives isathyde. The author speculated on the possibility of regenerating the indigotine by the action of a more powerful reducing agent on isatine, and with that idea heated isatine with hydriodic acid. Indigotine was not produced, but the author obtained isathyde, and three new bodies—1, a green body, *isatochlorine*; 2, a red substance, *isatopurpurine*; and 3, a white body, *isatone.* These bodies, the author states, have some analogies with the bodies prepared from sulphuretted isathyde by Laurent, but, nevertheless, are altogether different.

M. Gernez, whose paper "*On the Crystallisation of Supersaturated Solutions*" we lately published, now makes known an experiment which, to his mind, decides that sulphate of soda is present everywhere in the air. He distilled water in a platinum still to avoid suspicion from glass, and passed through this water air taken in the park at Talmay at a long distance from any houses. A few drops of the water evaporated on a plate of glass showed, under the microscope, crystals of sulphate of soda.

NOTICES OF BOOKS.

Researches on Thallium. By M. S. Nicklès. Nancy. 1865.

The eminent Professor of Chemistry at Nancy has in this publication collected the various papers he has published on the compounds of thallium. With one exception, these papers have already appeared in our pages, and it is unnecessary to notice them again, further than to acknowledge their great merit. The exception we have named is a short note on the use of chlorothallate of ammonia as a reagent, and this we shall publish in a future number.

Bulletin Mensuel de la Société Chimique de Paris. August, 1865.

The proceedings of the two last meetings of the Parisian Chemical Society offer some papers of considerable interest. We give now only the abstracts from the minutes of the Society. M. Naquet presented a note relating to Mr. Catton's paper on the synthesis of organic bodies which we published last year. M. Naquet states that he has not succeeded in forming malonic acid by the simultaneous action of carbonic and acetic acids and sodium, which, according to Mr. Catton, will produce malonic acid.

A paper "*On the Spectrum of Nitrogen*" was sent by M. Waltenhofen, who states that in an atmosphere of nitrogen properly rarefied the violet rays disappear before the blue and green. The author's observations lead him to believe that nitrogen is a compound body.

MM. Oppenheim and Pfaundler have produced, by the action of cyanide of potassium on dinitrophenic acid, a new acid, which they propose to call *metapurpuric acid,* indicating by the name the analogies with isopurpuric acid.

M. Schutzenberger described some researches on the products of the oxidation of morphia, among which he has found a new base, *Oxymorphine.*

M. Gautier has studied the "*Action of Hydriodic Acid on Hydrocyanic Acid,*" which he finds to combine, equivalent for equivalent, forming a white crystalline compound, which the author regards as an iodide of ammonium, in which the triatomic radical ȻH takes the place of three atoms of hydrogen, and which he consequently represents as—

$$N\left\{\begin{matrix}\text{Ȼ}H'''\\H\\I\end{matrix}\right.$$

We shall give a longer abstract of this paper.

Annalen der Chemie and Pharmacie. August, 1865.

The first paper in this number is by Erlenmeyer and Wanklyn "*On the Action of Hydriodic Acid on Mannite and Melampyrin.*" In both instances the authors obtained an iodide of the composition $\text{Ȼ}_6H_{13}I$, which they provisionally designate iodide of β hexyl since the alcohol ($\text{Ȼ}_6H_{14}\Theta$) derived from it differs from the hexylic alcohol of Faget. The authors have prepared many other derivatives from the iodide, full descriptions of which are given, theoretical considerations being avoided, the authors not being in accord on many points.

The next communication is by Bilfinger, "*On Azodracylic and Hydrazodracylic Acid.*" Nitrodracylic acid is obtained by the action of strong nitric acid on toluol. A concentrated solution of the soda salt

$$\left.\begin{matrix}C_{14}H_4(NO_4)O_2\\Na\end{matrix}\right\}O_2+6Aq.$$

treated with sodium amalgam gives a deep gold-yellow solution from which hydrochloric acid throws down a flesh-coloured precipitate of azodracylic acid $C_{14}H_5NO_4$. The author describes the soda, ammonia, baryta, and silver salts of this acid. Azodracylic acid, like its isomer azobenzoic acid, gives, on boiling with caustic soda and protosulphate of iron, another acid—hydrazodracylic acid $C_{14}H_6NO_4$—an isomer of hydrazobenzoic acid. In a postscript to this paper, Strecker expresses an opinion that Zinin's azobenzoic and the author's azodracylic acids are probably the same bodies.

In the next paper Dr. Haarhaus describes "*Hydrazoanilin,*" which he obtains by the action of sodium amalgam on nitraniline. The author writes the formula of the new body $C_{24}H_{14}N_4$. He also gives the following table, which will serve to show the relations of the bodies described in the previous paper:—

Aniline	$C_{12}H_7N$
Nitraniline	$C_{12}H_6(NO_4)N$
Azoaniline	$C_{24}H_{12}N_4$ (wanting)
Hydrazoaniline	$C_{24}H_{14}N_4$

Hydrazoaniline is a tolerably strong base, fusing at 160°, subliming for the most part undecomposed at a higher temperature. It forms crystallisable salts with acids. It is obtained in the form of long gold-yellow needles, which are but slightly soluble in water, but freely soluble in alcohol and ether.

We have another body of the same class described by Dr. Brigel, in a note entitled "*On a Product of the Reduction of Nitrosalicylous Acid.*" This acid ($C_{14}H_5(NO_4)O_4$) treated with sodium amalgam loses the oxygen of the group NO_4, and becomes *hydrazosalicylous acid* $C_{14}H_6NO_4$.

The next paper is by Werigo, "*On the Action of Sodium Amalgam on Nitrobenzol,*" the principal product of which is *azobenzid* $\text{Ɵ}_{12}H_{10}N_2$. The author describes several derivatives of azobenzid.

Several other papers of much interest are contained in this number, among which we may point out that by Dr. Erdmann "*On some Derivatives of Benzoin;*" Blomstrand "*On Niobium and Tantalum,*" in which we read that the author has determined the equivalent of the former metal to be about 40; Strecker "*On Some Salts of the so-called Peroxide of Thallium,*" to which we shall return; Feldmann "*On Laserpitin,*" an interesting body obtained from the root of Laserpitium latifolium; and Wickelhaus "*On the Action of Perchloride of Phosphorus on some Organic Acids.*"

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

1905. J. H. Chaudet, Rouen, "An improved system of manufacturing salts, sulphates, and acetates of chrome, and of applying them as mordants in dyeing and printing textile substances, both animal and vegetable."—Petition recorded, July 21, 1865.

2013. W. Morgans, Brendon Hill, Somerset, "Improvements in coke ovens and in the manufacture of coke."

2015. E. L. Ransome, Ipswich, "Improvements in paints or preparations for coating surfaces."—Aug. 3, 1865.

2019. P. Robertson, Jeffrey Square, London, "Improvements in brewing and distilling; also in drying yeast, and in the apparatus employed."

2023. J. A. Leon, G. Tessimond, and J. Kissack, Liverpool, "Improvements in apparatus for filtering sugar and other liquid solutions."—Aug. 4, 1865.

2053. J. Buchanan, jun., Barrhead, N.B., and R. Boyd, Glasgow, N.B., "Improvements in printing and dyeing yarns and fabrics of cotton or other vegetable materials."—Aug. 8, 1865.

Notices to Proceed.

966. W. Teall, Louis Lefraige, and E. T. Simpson, Wakefield, Yorkshire, "Improvements in the manufacture of lubricating oil and grease." A communication from E. Lepaulle, Paris.

970. E. Ritherdon, Fenchurch Street, "Improvements in protecting iron ships and other submerged structures from oxidation and corrosion."—Petition recorded April 6, 1865.

995. H. Edmonds, Gosport, "Improvements in lighting and ventilating ships, part of which is also applicable for producing fresh water at sea."—April 7, 1865.

1023. C. Vaughan, Birmingham, "Improvements in the manufacture of iron and steel."—April 11, 1865.

1776. J. Jobson, Derby, and J. F. Dickson, Leicester, "Improvements in the conversion of wrought or malleable iron into steel, and in the means or apparatus employed therein."—July 5, 1865.

CORRESPONDENCE.

On the Cause of Numerical Relations among the Equivalents.

To the Editor of the Chemical News.

Sir,—By way of addition to my last letter, I will, with your permission, endeavour to show that all the numerical relations among the equivalents pointed out by M. Dumas and others, including the well-known triads, are merely arithmetical results flowing from the existence of the "law of octaves," taken in connection with the fact of the equivalents forming a series of numbers approaching to the natural order, as may be observed by an inspection of the following table:—

Symbol.	No.	Eq.	Eq.÷No.	Symbol.	No.	Eq.	Eq.÷No.
H	1	1	1	Br	29	80	2·758
Li	2	7	3·5	Rb	30	85	2·833
G	3	9	3	Sr	31	87·5	2·823
Bo	4	11	2·75	Zr	32	89·5	2·797
C	5	12	2·4	Ce	33	92	2·788
N	6	14	2·333	Di	34	96	2·824
O	7	16	2·286	Ro	35	104	2·971
F.	8	19	2·375	Pd	36	106·5	2·958
Na	9	23	2·555	Ag	37	108	2·919
Mg	10	24	2·4	Cd	38	112	2·947
Al	11	27·5	2·5	Sn	39	118	3·026
Si	12	28	2·333	U	40	120	3
P.	13	31	2·385	Sb	41	122	2·975
S.	14	32	2·286	I.	42	127	3·024
Cl	15	35·5	2·367	Te	43	129	3
K	16	39	2·437	Cs	44	133	3·023
Ca	17	40	2·353	Ba	45	137	3·044
Ti	18	50	2·778	Ta	46	138	3
Cr	19	52·5	2·763	W	47	184	3·915
Mn	20	55	2·75	Nb	48	195	4·062
Fe	21	56	2·667	Au	49	196	4
Co	22	58·5	2·659	Pt	50	197	3·94
Cu	23	63·5	2·761	Os	51	199	3·902
Yt	24	64	2·667	Hg	52	200	3·846
Zn	25	65	2·6	Tl	53	203	3·83
In	26	72	2·769	Pb	54	207	3·833
As	27	75	2·778	Bi	55	210	3·818
Se	28	79·5	2·839	Th	56	238	4·25

In this table the first column of figures gives the numbers of the elements; the second, their equivalents; and the third, the product obtained by dividing the equivalent of an element by its number. It will be seen that the number of an element is nearly equal to its equivalent divided by a certain sum, which varies, however, as we ascend the scale, thus—

From 4 to 17, the No. = Eq. ÷ 2·5
From 18 to 34, the No. = Eq. ÷ 2·75
From 35 to 46, the No. = Eq. ÷ 3
From 47 to 56, the No. = Eq. ÷ 4

Now, as the equivalents correspond more or less closely in their rate of increase to the numbers of the elements, anything that is true of the latter must, with a certain amount of latitude, be true of the former also; and, therefore, if the number of one element is the mean of those of two others (whether belonging to the same group or not), its equivalent will also be the mean of their equivalents.

Thus the number of Ti, 18, is the mean of those of F, 8, and Se, 28, and the equivalent of Ti = 50 is also the mean of those of F = 19 and Se = 79·5, thus—

$$\frac{19 + 79\cdot5}{2} = 49\cdot25.$$

This is only one example of many that I might adduce of elements, whether analogous or not, possessing intermediate numbers, and also intermediate equivalents.

Now, in conformity with the "law of octaves," elements belonging to the same group generally have numbers differing by seven or by some multiple of seven—that is to say, if we begin with the lowest member of a group, calling it 1, the succeeding members will have the numbers 8, 15, 22, 29, 36, &c., respectively.

But 8 is the mean between 1 and 15; 15 is the mean between 8 and 22; 22 is the mean between 15 and 29, &c.; and, therefore, as an arithmetical result of the "Law of Octaves," the number of an element is often the exact mean of those of two others belonging to the same group, and consequently its equivalent also approximates to the mean of their equivalents.

The real triad exists in the numbers of analogous elements, as a consequence of their differing by some multiple of a regularly recurring number—viz., 7. The triad of M. Dumas is only an approximation to the former, and is due to the partial concordance between the equivalents of the elements and their respective numbers.

A similar train of reasoning will explain why it is that on deducting the equivalent of the lowest member of a group from that immediately above it we obtain a constant number (about 16). For we find that if, instead of taking elements of the same group (that is, elements whose numbers differ by 7,) we perform a similar calculation with elements whose numbers differ by 8 or by 9, &c., we obtain in each case numbers quite as constant as in the above. The difference of about 16 merely expresses the average difference for an interval of seven elements in the lower part of the scale of equivalents.

The above remarks are merely offered as an attempt to indicate, in a general manner, the mode in which the existence of arithmetical relations among the equivalents may, at any rate, be partially explained.

I am, &c.,
John A. R. Newlands, F.C.S.

Laboratory, 19, Great St. Helens, E.C., August 15.

Crystallisation of Bromide of Potassium.

To the Editor of the Chemical News.

Sir,—In the Chemical News of the 4th ult. there appeared a report by Mr. Tichborne in reference to the Dublin International Exhibition. He therein directs attention to a remarkably fine specimen of bromide of potassium, and states:—"It is a fact that a small quantity of the iodide makes the bromide crystallise in much larger crystals." In practice I have found the reverse to be the case, although French and German bromine is rarely or ever quite free from iodine, which is really the way in which the iodide is introduced into the bromide. Any excess, however, of iodide contained in the bromide is readily removed; but, practically, traces are not easily separated. After the separation of all but traces of iodine, the salt then forms very sharp and well-defined cubes, far more so than the iodide, the opacity, or transparency, and size of the crystal depending upon the manipulator. In support of this conclusion, I operated upon a quantity of bromine manufactured in Scotland a few months since as an experiment. This bromine did not give the faintest indication of the presence of iodine on the addition of starch acidified with hydrochloric acid and nitrite of potassa, but furnished large cubes of great beauty.

I am inclined to think the idea that a well-developed cube must contain iodide will be found to be altogether erroneous. I am, &c.

William Huskisson, jun.

Swinton Street, Gray's Inn Road, August 17.

Skeleton Leaves.

To the Editor of the Chemical News.

Sir,—The most expeditious method of removing the cellular from the vascular tissue of leaves, and thereby "skeletonising" them, is not that suggested by your correspondent a fortnight ago, but the following:—

The leaves are boiled for two minutes, then transferred to a strong solution of permanganate of potash and gently heated. In an hour or two the laxer tissues may be easily removed by means of a brush. Sulphurous acid or a solution of chloride of lime may be used for bleaching them.

The stains of permanganate of potash upon the fingers are, of course, easily washed off by dilute sulphuric acid.

I am, &c. H. J. Church.

Cambridge, August 22.

MISCELLANEOUS.

North London Exhibition.—If the naked truth must be told, we are bound to say that the Agricultural Hall looks very bare, and considering what they have to exhibit it would have been well if the Committee had contented themselves with less space. The redeeming point is, that, for the most part, what is shown is of great excellence, and this is especially true of the articles which call for a notice from us. To commence with the chemical exhibitors, we may say that the cases shown by Messrs. Morson and Son, of Southampton Row, and by Mr. How, of Foster Lane, would attract notice in any exhibition. Both exhibitors confine themselves mostly to photographic chemicals. Those of Messrs. Morson are remarkably fine, having, in fact, more the appearance of museum specimens than commercial samples. The iodide and bromide of cadmium, and the gallic and pyrogallic acids are very beautiful specimens, and there is some well crystallised iodide of ammonium of an unusually good colour. The Messrs. Morson also exhibit one pharmaceutical preparation, a new remedy for cholera, which we sincerely hope no one will have an opportunity of trying. Mr. How's case also contains some fine samples of photographic chemicals, having what we may call a reasonably commercial look—that is, they appear like the best articles that can be bought across the counter. The iodide of cadmium has a superior look, and so has the pyrogallic acid. Some very pretty specimens of other than photographic chemicals also find a place in this case, among which is a quantity of that beautiful coloured compound the sesquichloride of chromium. A very fine looking specimen of nitrate of uranium is also shown; the whole contents of the case, indeed, have a very creditable appearance. Messrs. Johnson and Sons have a case containing very large crystals of nitrate of silver, and also open dishes of very fine crystals marked respectively chloride of gold and chloride of platinum "for photographic purposes." The crystals of chloride of gold are very dry, and are no doubt permanent, and they are said to be guaranteed to contain the quantity of gold stated on the label, which appears to be seven grains of gold in fifteen grains of the salt. Now, we have no doubt that this is a very useful salt for toning, but it would be as well to say what it is. Photographers in these days are mostly chemists, and understand that a definite chemical compound needs no verbal guarantee for the proportions of its constituents. It would be far better to label the salt with its proper chemical name, and then a photographer can always calculate its composition. We have, however, no objection to say that, whatever they are, the salts look very beautiful. We shall notice some of the philosophical apparatus on a future occasion.

Explosive Force of Nitro-Glycerine.—Experiments have been made in the open workings of the tin mines of Altenburg, in Saxony, by M. Nabel, which prove that the use of nitro-glycerine for blasting purposes is quite practicable. Its chief advantage is, that it requires a much smaller hole or chamber than gunpowder does, the strength of the latter being scarcely one-tenth of the former. If the boring presents fissures, it must first be lined with clay to make it watertight; this done, the nitro-glycerine is poured in, and water after it, which being the lighter liquid, remains at the top. A fuse is then applied in the usual manner. In one of the experiments referred to a bore-hole 1⅜-inch in diameter was made perpendicularly in a dolomitic rock, 60 feet in length, and at a distance of 14 feet from its extremity, which was nearly vertical. At a depth of 8 feet a vault filled with clay was found, in consequence of which the bottom of the hole was tamped, leaving a depth of 7 feet. Nearly three pints of the nitro-glycerine was then poured in—it occupied 5 feet; a match and stopper were then applied, as stated, and the mine sprung. The effect was so enormous as to produce a fissure 50 feet in length, and another of 20 feet. The total effect has not yet been ascertained, because it will require several small blasts to break the blocks that have been partially detached by this.

Metallic Tungsten.—We learn that a Swedish metallurgist has discovered a method of reducing tungsten, by which he obtains it at once in a state of fusion, and that ingots of the pure metal weighing several pounds each are now on exhibition at Stockholm. We are informed, too, that the cost of obtaining tungsten by the new method does not exceed a few shillings per pound. If really obtainable thus cheaply, a metal which will bear exposure to so intense a heat without undergoing either fusion or oxidation must prove of incalculable value to certain of the arts, provided that the difficulties in the way of working it are not insuperable. With the exception of gold and platinum, tungsten is the heaviest metal yet known. Its specific gravity is about 18, that of gold being 19·36, and that of platinum 21·53.—*Mechanics' Magazine.*

Bismuth.—This metal has of late years risen considerably in price. Amongst other causes, some journals have stated that two or three years ago a company was formed to work an invention by which gold was to be made by the transmutation of bismuth into that metal, and that large quantities of the former metal had been bought up for this purpose. Whether such an enterprise was or was not entered upon does not appear. The following is a list of the prices:—

	s.	d.		s.	d.		
1844 . .	0	10	to	2	0	per pound.	
1845 . .	2	0	,,	4	0	,,	
1846 . .	4	0	,,	3	3	,,	
1847 . .	3	3	,,	2	6	,,	
1848 . .	2	6	,,	2	0	,,	
1849 . .	2	0	,,	2	6	,,	
1850-7. .	2	6,	2s,	2	6	,,	
1858 . .	2	6	,,	3	6	,,	
1859 . .	3	6	,,	4	6	,,	
1860 . .	4	6	,,	6	6	,,	
1861 . .	6	6	,,	9	6	,,	
1862 .	9	6	,,	20	0	,,	in July.
	11	0		—		,,	in December.
1863 . .	11	0	,,	10	6	,,	
1864 . .	10	6	,,	11	0	,,	
1865 . .	10	6	,,	11	0	,,	

Up to 1844, a large quantity of bismuth was produced in this country from cobalt ores in the old way of refining, but a new way of treating such ores, then introduced, necessitated the loss of much of the bismuth, and since that time we have been chiefly supplied from the Saxon and Bohemian mines. In 1845 there was a large demand for a composition to make rollers for calico-printers, raising the price for a few months. In 1858 the supply began to fall off, and in 1861-2 there was a very large extra demand for medicinal preparations, which, to a certain extent, still continues, but the demand for mechanical use has since that time been very trifling. New sources of supply are opening, and prices, it is said on good authority, are likely to fall.—*Journal of the Society of Arts,* M. F. 5, viii., 65.

New Forms of Anæsthetics.—Mr. Nunneley showed to the members of the British Medical Association two substances, the bromide of ethyl and the chloride of olefiant gas, which for some time past he had used as anæsthetics. He stated that he had not lately performed any serious operation, either in private practice or at the Leeds General Infirmary, without the patient being rendered insensible by one or other of these agents; each of which he believed to possess important advantages over chloroform. They were amongst the many analogous bodies experimented upon by him, and were favourably mentioned in his essay upon Anæsthesia which was published in the *Transactions* of the Association for 1849. At that time the difficulty and cost of their manufacture were too great to allow of their being commonly used. This difficulty had, however, been overcome; and, should their use become general, they can be made at a cost not exceeding that of chloroform, if not at less. They both act speedily, pleasantly, and well. The patient might be kept insensible for any length of time, while the most painful and prolonged operations were being performed. No disagreeable symptoms had in any case resulted from their use.

The Copper Smoke Question.—For many years past the subject of utilising or neutralising the effects of the obnoxious copper smoke has received much attention from practical chemists and the smelters engaged in the trade. In the neighbourhood of Swansea, where there are large copper works, the effect of the smoke is such that vegetation is completely destroyed for miles around, and the result is that the copper smelters have to pay enormous sums of money as compensation for the land that is thus rendered valueless. Various remedies have been attempted to neutralise the poisonous effects of the smoke, such as high stacks, conductors, condensers, &c., but only a limited degree of success has been attained. It is well known that the smoke possesses some valuable properties, which, if separated from the other ingredients, could be utilised and made profitable, and nearly all the inventions proposed have had these objects in view, but hitherto, as already stated, the attempts have ended in failure. Messrs. Vivian and Sons, the extensive copper smelters, have recently determined to adopt the patent of a German chemist, and Mr. H. H. Vivian, M.P., the senior partner, has stated publicly that he believes, after a careful investigation, that the invention will prove completely successful, and that it will enable the firm to make 1000 tons per week of sulphuric acid from the copper smoke, which is now not only of no value, but a source of great loss, owing to its injurious effects on the surrounding vegetation. The completion of the necessary works is looked forward to with especial interest by those who are engaged in the copper-smelting trade.—*Times.*

[Mr. Spence has already taken out several patents for effecting this object, which is successfully carried out at his works near Manchester.—Ed. *C. N.*]

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. XI. of the Chemical News, containing a copious Index, is now ready, price 11s. 0d., by post, 11s. 6d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. XII. commenced on July 7, 1865, and will be complete in 26 numbers.

Received, with thanks.—R. C. M.; C. M. Warren; J. B.

Mona.—We cannot understand our correspondent's request, or would oblige him if possible.

J. H.—The material to use for preserving would depend upon the purpose to which the substance is to be applied. Either acetic acid or corrosive sublimate would answer, but the latter is a poison. Carbolic acid also would do.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On a Process of Fractional Condensation, applicable to the Separation of Bodies having small Differences between their Boiling Points, by C. M. Warren.

(Continued from page 86.)

Of the New Process.—The chief distinctive feature of my process, as compared with the common one, consists in this, that the operator has complete and easy control of the temperature of the vapours given off in distillation, and consequently can readily cool these vapours to the lowest limit of temperature which the most volatile portion, under the circumstances, is able to bear and retain its vaporous condition. It will be seen at a glance that, under these conditions, the operator has it in his power to secure in any case the very largest possible amount of condensation of the heavier from the lighter vapours. The liquids resulting from the condensation of the less volatile portions of course fall back into the retort, while the vapours of the more volatile parts continue to go forward to a cold condenser, descending in the opposite direction, from which the condensed product falls into a special receiver. In this manner he is able to obtain in each successive operation a series of products which shall contain the minimum quantity of the less volatile constituents which a single distillation is capable of affording.

Of the common process, on the contrary, nearly the reverse of all this is true, the operator having no control whatever, being forced to receive the vapours at the temperature which they naturally acquire in passing from the retort, and laden with such proportion of the less volatile bodies as may be carried forward with them.[‡‡]

In the new process, perfect control of the temperature of the vapours is secured by simply conducting these vapours upward through a worm contained in a bath, *aa*, Figs. 1 and 2,[§§] the temperature ot which is regulated by means of a separate lamp, *b*, Fig. 2, or by a safety furnace, *p*, as shown in Fig. 1. The bath may be of oil or water, or of metal for very high temperatures, as the case may require, and is furnished with a thermometer, *t*.

That this bath may be equally adapted for the separation of liquids boiling below the common temperature, an empty vessel, *c*, Fig. 1 and 2, is permanently secured in the interior of the bath by means of straps of metal across the top to serve as a convenient receptacle for ice or iced water, by means of which a low temperature may be steadily maintained. This interior vessel also serves a good purpose in economising time and fuel in heating the bath, as it diminishes the quantity of oil required to cover the worm. It is made to extend to within about three inches of the bottom of the bath, and large enough to fill the greater part of the space in the centre of the coil. The bath and interior vessel are both made of sheet copper, with joints brazed so that they will bear a high temperature. I generally use also copper worms, especially in the earlier distillations, the quantities then operated upon being larger, as such worms are conveniently procured and not liable to break. In the larger sized apparatus, the tube of which the worm is made measures ten feet in length and half an inch in diameter. I have tried several lengths of worm and several diameters of tube, but not as yet with any special view of determining the precise proportions, in relation to the size of the retort, which would be best adapted to the purpose. There appears, however, to be nothing gained by increasing the length of the worm beyond what is required to reduce the temperature of the vapours to that of the bath I have in use three sizes of apparatus. The largest has a copper worm 10 feet long and $\frac{1}{2}$ inch bore; the medium size, a worm 5 feet long and $\frac{3}{8}$ inch bore; and the smallest size, for very small quantities, a worm 1 foot 6 inches long and $\frac{1}{4}$ inch bore. Each of these has been found to answer a good purpose. The distillation may be conducted in a glass flask, or more conveniently in a glass retort of the form shown at *d*, Figs. 1 and 2. The body of this retort, as appears in the figure, is of the form of the corresponding part of the common retort, but which, in place of a long neck, has only a short tubulure, *e*, in the side, for escape of the vapours, and another tubulure, *f*, in the top, which contains the thermometer, and through which the retort is charged.

In the larger apparatus the retort is connected with the lower end of the elevated worm by means of a glass tube of about the same diameter as the end of the worm. One end of this tube enters the retort at the lateral tubulure through a perforated cork, and the other end is joined to the end of the worm either by being firmly bound with a strip of cloth thickly covered with vulcanised caoutchouc—such as is found in commerce—or by means of a perforated cork, which is made to fit the ends of both tubes as snugly as possible, and then tightly pressed together upon the joint by means of an iron clamp, as shown at *g*, Fig. 2. This clamp is figured on a larger scale at E. As it is highly important that all joints in the apparatus should be perfectly tight, inasmuch as the least leakage, when continued a long time, would cause in the aggregate a serious loss of material, I would call special attention to the clamp joint as the best which I have tried. Before falling upon this device I had used exclusively the vulcanised caoutchouc joints, which were found to answer a good

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[‡‡] The only apparatus of which I have any knowledge which can be regarded as bearing any analogy to my own is that employed in the rectification of alcoholic spirits on a manufacturing scale. In one of the older forms of this apparatus, that of Solimani, to which my attention was first called by a friend, after my process had been in use more than a twelvemonth, the temperature of a dephlegmator is kept within such limits as to give alcohol of any required strength more readily than by the common methods. The mode of construction of this apparatus is, however, only adapted to manufacturing purposes, and it could not be utilised in the more exact experiments required in scientific research. Either on account of its complication, or some other cause, the apparatus of Solimani has, I believe, long since been abandoned.

Mansfield (*Quarterly Journal* of the Chemical Society, 1849, i. 264), observing that "the boiling point of benzole is the same as that of alcohol of sp. gr. 0·815," remarks that "any of the summary processes of rectification which are practised by distillers in the manufacture of alcoholic spirits are applicable to the separation of benzole from the less volatile fluids of naphtha;" and appended to his scientific treatise on coal tar, under the title "Of a Practical Mode of Preparing Benzole," goes on to describe a process for that purpose, which I believe he had previously patented. It appears that Mansfield did not employ this process in his research, but obtained his benzole, as well as the other less volatile hydrocarbons, in the usual manner—by simple distillation.

In the belief that no process of fractioning at all analogous to mine has ever been employed in scientific research, and that I am not in any way directly indebted to any of the devices of my predecessors, I have taken no special pains to consider these devices in much detail. I may say, however, that I have found no record of any one's ever having employed the oil bath and a separate fire to regulate a heated condenser, this being the essential feature on which the superiority of my process is based, adapting it at once to both high and low temperatures and for the most delicate work.

The employment of bulbs above referred to, as proposed by Wurtz, is simply a modification of the old process. The bulb apparatus furnishes the same, or at most but slightly better, results than a simple retort, being no more than equivalent to increasing the height of the neck of the retort itself, without introducing any control over the accuracy of the results, the only advantage gained being that these results are obtained somewhat more quickly.

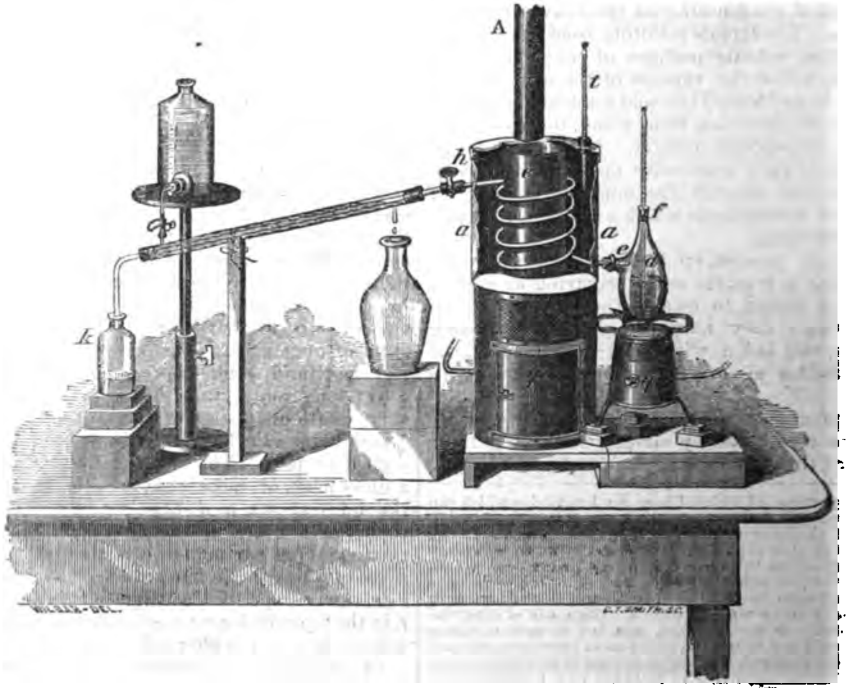
[§§] We owe these illustrations to the kindness of the author, who has been good enough to forward them from America.

purpose in most cases, except that they required too frequent renewal. I have found the cloth covered with vulcanised caoutchouc preferable to the common caoutchouc tubing. In the smaller sizes of apparatus I have the end of the worm itself project far enough from the bath to connect directly with the retort by means of a perforated cork, without the use of an additional connecting tube.

The upper end, *h*, of the elevated worm is brought out through the side of the bath at a point about three inches below the top, so that, when working with a low temperature of the bath, the worm may still be completely covered with oil, and also give sufficient space above the worm for the expansion of the oil when higher temperatures are employed. To avoid contaminating the atmosphere of the laboratory with the disagreeable fumes which are given off in large quantity from such a mass of heated oil, the top of the bath is tightly closed with a sheet iron cover, from which a small funnel, A, Fig. 1, conducts these fumes to a chimney.

In the larger apparatus, the vapours which succeed in passing through the heated worm are conducted downward into a cooled worm contained in a bath of water, *ii*, Fig. 2, and the liquid product is collected in the receiver, *k*. The cold bath, *ii*, contains two condensing worms—one for each apparatus—and is large enough to condense for both without the necessity of renewing the water. I have represented two apparatuses combined, as it will be found more economical of time to operate with two at once. In the smaller apparatus for the table, a Liebig condenser may be conveniently substituted for the cold worm, as shown in Fig. 1.

FIG. 1.

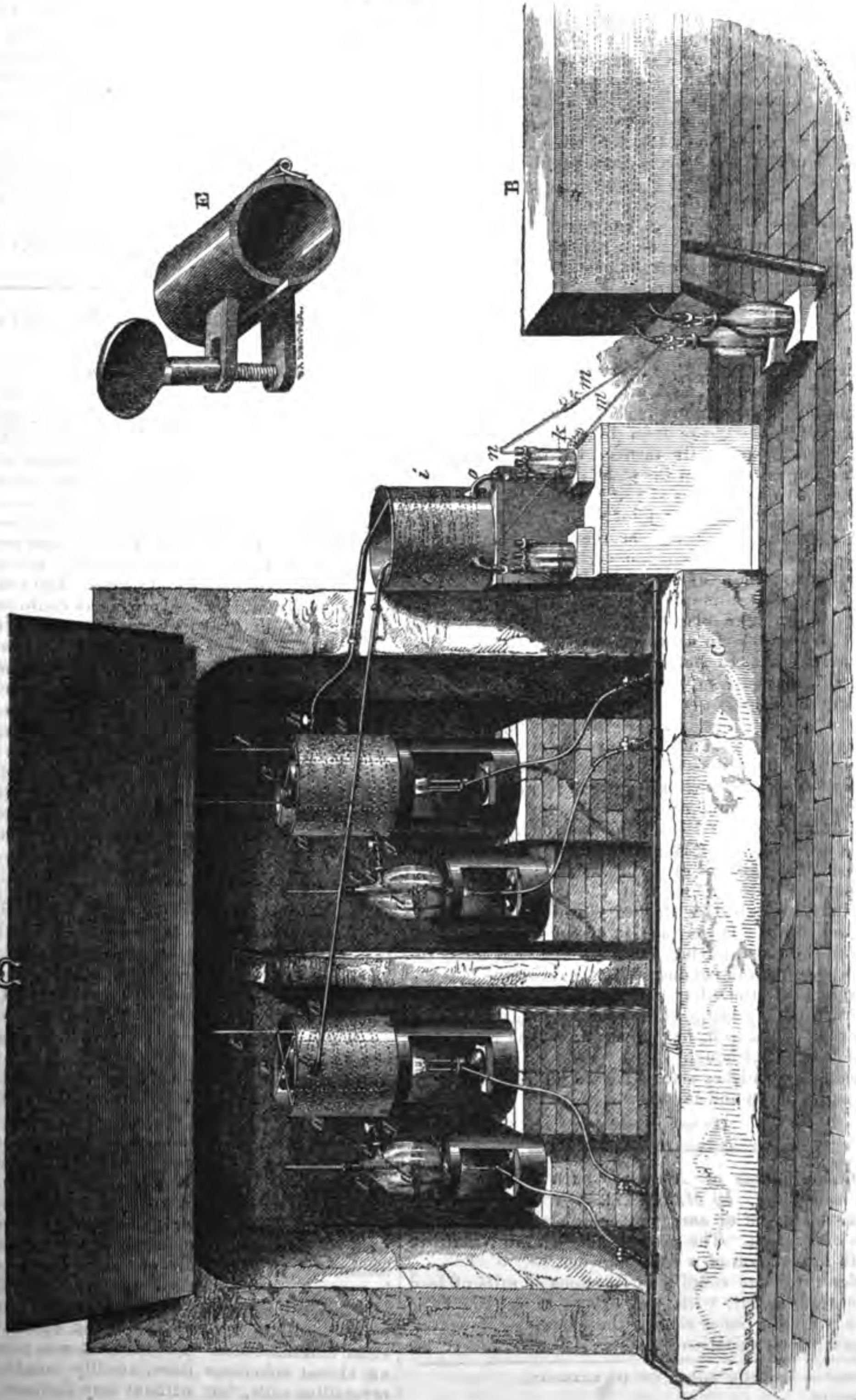


For collecting liquids which boil below the common temperature, when such are present, I attach a refrigerator, B, Fig. 2, which is provided with two block tin condensing tubes—one for each apparatus. These are bent in a zigzag form, and attached to the inner sides of the refrigerator. The lower ends of the tubes extend through the end of the refrigerator far enough to form a convenient connexion with the second receiver, *l*, Fig. 2, which communicates with the first receiver, *k*, by means of the glass tube, *m*.

In order to successfully collect and condense the vapours of such extremely volatile liquids as are now under consideration, it is of course indispensable that the apparatus should be constructed with very tight joints; and for greater convenience, but more especially to prevent breakage, such of the joints as require to be frequently taken apart should be made flexible. A very convenient and perfectly tight joint of this kind may be made as follows:—The short stationary tube, *n*, in the cork of the receiver, *k*, Fig. 2, is made with the opening somewhat divergent upward; the end, *o*, of the worm is enough smaller than the inside diameter of the upper end of the tube, *n*, to leave room for a piece of caoutchouc tube to be drawn over it and still admit of its being inserted in the end of the tube, *n*; the flexible tube is drawn on far enough to prevent the drops which form on the end of the worm from coming in contact with the caoutchouc; a perfectly tight and convenient flexible joint is now made by pressing the tube, *n*, over the caoutchouc covering of the end of the worm, *o*. The joints of the receivers, *ll*, are made in the same manner.

The vapours which escape condensation in *ii* pass through the receivers, *kk* and *ll*, to the refrigerator, B, which contains ice or a mixture of ice and salt, are there condensed and fall back into the receivers, *ll*, which should stand in a wooden vessel also containing ice or a freezing mixture. The refrigerator, B, is made with double bottom and sides, with an inch space between, which is filled with pulverised charcoal. Being tightly covered, a charge of ice and salt will serve for a long day's operations without renewal. In this manner I have been able to collect in considerable quantity bodies

FIG. 2.



boiling nearly at 0° C., and this from mixtures in which such bodies had been quite overlooked by previous investigators.

It will be observed, on reference to Fig. 2, that the larger distilling apparatus is represented as standing in a brick fire-place, with brickwork, CC, a few inches high, built up in front, and a sheet iron apron, DD, folded above. This is for security against fire in case of accident, either to the retort or hot bath of oil. As arranged, the contents of either or both of these could run out and burn without danger to the operator or the premises, as the brickwork in front would prevent the liquid from spreading beyond the fire-place, and the dropping of the sheet iron apron would cause an additional draught, and thus insure the passage of the flames into the chimney. Instead of placing the apparatus in a fire-place, where that is not convenient, equal security against accidents may be attained by the use of my safety heating lamp,‖‖ *q*, Fig. 1, to heat the retort, and safety furnace, *p*, containing a Bunsen's burner, for heating the bath. The bottom of this furnace, and also a large part of the sides, is formed of wire gauze, such as described for the safety lamp.¶¶ The gauze upon the bottom need not be permanently attached to the furnace, but may be simply laid over an opening cut in the stool or board on which the furnace is to be placed; if the furnace be then set upon it, taking care that the joint shall be tight around the edge, nothing more will be required. A strip of vulcanised caoutchouc, about an eighth of an inch in thickness, is riveted around the edge of the opening for the door. Against this the door tightly closes, so that no ignition can take place through the cracks which would otherwise remain under the edges of the door.

For an apparatus to stand upon the table, the safety lamp and furnace are especially desirable. I have also used them for the larger apparatus, placed upon the floor of the laboratory. As a practical test of the security which they afford, I may relate an incident which happened to myself. I had left the laboratory for a short time with such an apparatus in full operation, the retort containing nearly a quart of light petroleum boiling below 100° C. Having been detained longer than I expected, on returning I found the laboratory filled with the vapours of hydrocarbons; and on approaching the retort, found that the caoutchouc joint, connecting the retort with the elevated worm, had failed, and that the larger portion of the liquid had distilled into the room, having been mainly condensed in the upper worm, and conducted thence down the outside of the retort into the safety lamp. This process was still going on, the lamp being highly heated from the excess of fuel thus added to it, but no ignition took place outside the lamp. Although this experiment was rather injudicious, it furnishes a valuable test of the efficiency of the safety lamp and furnace.

(To be continued.)

Chlorothallate of Ammonia as a Reagent, by M. NICKLÈS.

CHLOROTHALLATE of ammonia completely precipitates nitrate of bismuth. The precipitate is chlorothallate of bismuth in the form of a white powder.

Under the same conditions solutions of salts of lead remain transparent, with the exception of the basic acetate, which becomes cloudy, the cloudiness, however, disappearing on agitation.

We have here, then, a rare example of the precipitation of one of these salts under conditions which do not appear to affect the other. Chlorothallate of ammonia, therefore, would appear to be useful in the laboratory as a means of quickly distinguishing bismuth from lead. Whether it is of use in completely separating one of these metals from the other remains to be decided. Bromothallate of ammonia has the same reaction as the chlorothallate.

It may be as well to add that chlorothallate of ammonia is most easily formed by treating chlorothallic ether or alcohol (see CHEMICAL NEWS, vol. ix., p. 241) with sal ammoniac. The salt is obtained in the form of beautiful colourless six-sided tables, which are soluble in alcohol and in water.

PHARMACY, TOXICOLOGY, &c.

On Diffusion of Fluids by the Atomiser for the Purposes of Deodorisation and Disinfection.

AT the recent meeting of the British Medical Association, Dr. Richardson explained a process he had adopted for applying the atomiser for the purpose of deodorisation. He made a mixture by adding iodine to solution of peroxide of hydrogen until saturation occurred, and afterwards concentrated sea-salt in proportion of 2½ per cent. In this combination a water was produced like sea-water, and which was rendered active by being charged with free iodine and ozone. The solution placed in one of Krohne's hand atomisers could be diffused in the finest state of distribution at the rate of two fluid ounces in a quarter of an hour; but in an ordinary bedroom or sitting-room one ounce was sufficient to render the air so active that ozone test-papers were discoloured by it to the highest degree of Moffatt's scale in from five to ten minutes. For charging the sick room rapidly and effectually with active air—in a word, with sea-air—Dr. Richardson said this plan was by far the most effective of any he had known. A nurse could put the apparatus into action at once, and could deodorise hour by hour, according to the directions of the Medical Practitioner.

Calabar Bean—Its Alkaloid, by FERDINAND F. MEYER.

SOME sixty beans were kindly contributed by Professor Torrey towards the preparation of the alkaloid. A preliminary examination proved that the base, as well as its its salts, were colourless, and whenever they became coloured a loss was sustained. To avoid evaporation as much as possible, I adopted the following method:—The beans were reduced to moderately fine powder, and repeatedly digested with 85 per cent. alcohol, and then displaced with alcohol of the same strength. The tincture was subjected to distillation, while the residual powder was boiled with dilute sulphuric acid until all of the starch had disappeared. The residual extract from the tincture and the acid solution were then mixed, filtered and precipitated with iodohydrargyrate, the precipitate washed by decantation, transferred to a cask with good stopper, in which it was treated with a strong solution of protochloride of tin in tartrate and bicarbonate of soda, and then with ether. The colourless ethereal solution was distilled, the soft residue redissolved in dilute sulphuric acid, and again treated with ether and ammonia. The alkaloid was now obtained as an almost colourless mass, readily combining to form crystalline salts, but without any distinctive reactions

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‖‖ *American Journal of Science*, 1861 (2), xxxiii. 275.

¶¶ *Loc. cit.*

On dissolving the impure alkaloid in acids, a reddish-brown substance separates, which, from the experiments made with it, may be assumed to be inert.—*Amer. Jour. of Pharmacy.*

PHOTOGRAPHY.

On the Nature of the Invisible Photographic Image, by M. CAREY LEA.

SOME experiments in which I have lately been engaged seem to me to finally settle the long-contested question as to the nature of the invisible photographic image, and I hasten to write a very brief description of them.

The view that the change which takes place in iodo-bromised plate in the camera is a purely physical one, that no chemical decomposition takes place, and neither liberation of iodine nor reduction of silver, has obtained a pretty general acceptance. But latterly it has been opposed by two distinguished photographers—Dr. Vogel and Major Russel. The former affirms that iodide of silver is never sensitive unless there is a body present capable of taking iodine from it under the influence of light. And Russel believes that the developed image is chiefly produced at the expense of the silver haloid in the film.

The following experiments seem to me to decisively close this controversy in favour of the physical theory:—

Experiment 1.—If the iodide or bromide of silver in the film undergoes decomposition in the camera, and, still more, if the developed image is formed at its expense, the film of iodide-bromide must necessarily be greatly consumed in the development under the dense portions of the negative, which it has contributed to form.

To settle this point, I exposed and developed an iodo-bromised plate in the ordinary manner. Then, instead of removing the unchanged iodide and bromide by fixing in the ordinary manner, I took measures to remove the developed image without affecting the iodide and bromide. This I succeeded in doing with the aid of a very weak solution of acid pernitrate of mercury. Now, if the iodide, or bromide, or both, had been in any way decomposed, to form, or aid in forming the developed negative image, when this came to be removed there should have been left a more or less distinct positive image, depending upon varying thicknesses of iodide and bromide in the film, much like a fixed negative that has been completely iodised. Nothing of this sort was visible, the film was perfectly uniform, just as dense where an intense sky had been as in those parts which had scarcely received any actinic impression, and looking exactly as it did when it first left the camera, and before any developer had been applied.

This experiment seems sufficiently decisive. But the following is far stronger.

Experiment 2.—A plate was treated in all respects as in No. 1, except that the application of the nitrate of mercury for removing the developed image was made by yellow light. The plate now showing nothing but a uniform yellow film, was carefully washed, and an iron developer, to which nitrate of silver and citric acid had been added, was applied. In this way the original image was reproduced, and came out quite clearly with all its details.

Now, as every trace of a picture and all reduced silver had been removed by the nitrate of mercury, it is by this experiment absolutely demonstrated that the image is a purely physical one, and that after having served to produce one picture, that picture may be dissolved off, and the same physical impression may be made to produce a second picture by a simple application of a developing agent.

P.S.—Since the above was written, I have repeated the experiment with a pyrogallic development with similar results. Both the first and second developments may be made with an iron developer or both with a pyrogallic. The experiment succeeds without the least difficulty in either way.—*Am. Jour. Science and Arts*, vol. xi., No. 118.

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"*On Animal Chemistry.*" A course of Six Lectures by WILLIAM ODLING, M.B., F.R.S., F.R.C.P.

Friday, May 5, 1865.

LECTURE 4.

(Concluded from page 92.)

Before proceeding, however, to exemplify this power of producing organic compounds artificially, I will make one or two further remarks upon their natural production. At present we are unable to trace the series of changes, undergone by carbonic acid and water, which result in the formation of tartaric acid, or sugar, or fat, or other complex vegetable product. It seems probable, however, that the process by which such bodies are formed does not consist in the simultaneous deoxidation of several atoms of carbonic acid into one complex molecule, as illustrated by the equation used in my last lecture to explain the production of mannite,—

$$\begin{array}{ccccccc}\text{Carbonic anhyd.} & & \text{Water.} & & \text{Oxygen.} & & \text{Mannite.}\\ 6CO_2 & + & 7H_2O & - & 13O & = & C_6H_{14}O_6;\end{array}$$

but that a series of more and more complex, less and less oxidised, intermediate bodies are successively formed, by the fixation of deoxidised carbonic acid upon the first-produced compounds. For example, we may conceive mannite to be built up somewhat in this manner. By a simultaneous dehydration and deoxidation of two molecules of carbonic acid, we should first obtain oxalic acid thus:—

$$\begin{array}{ccc}\text{2 Carbonic acid.} & & \text{1 Oxalic acid.}\\ C_2H_4O_6 - (H_2O + O) & = & C_2H_2O_4.\end{array}$$

Then by a further deoxidation of oxalic and carbonic acids, we might obtain tartaric acid, thus:—

1 Oxalic acid . . .	$C_2H_2O_4$
2 Carbonic acid . . .	$C_2H_4O_6$
	$C_4H_6O_{10}$
4 Oxygen	O_4
Tartaric acid . . .	$C_4H_6O_6$

Lastly, by a joint deoxidation of tartaric acid, carbonic acid, and water, we might obtain mannite, thus:—

1 Tartaric acid . . .	$C_4H_6O_6$
2 Carbonic acid . . .	$C_2H_4O_6$
2 Water . . .	H_4O_2
	$C_6H_{14}O_{14}$
8 Oxygen	O_8
Mannite	$C_6H_{14}O_6$

The actual occurrence of these particular actions is quite unproven; but that some such actions take place is rendered highly probable by a variety of considerations. Thus, in the gradual development and ripening of the olive, we find certain vegetable acids replaced by mannite, and at a later stage the mannite itself replaced by the less oxidised and more complex oleine. Moreover, the compounds formed in one organ of a plant are known to be transferred, in a more or less altered form, to other organs, in which they become accumulated; and it is not improbable that certain vegetable products of deoxidised carbonic acid and water may have undergone a partial reoxidation, or even several alternate reoxidations and deoxidations, in the course of their history. Similarly in animals, although the ultimate process is one of oxidation, we know that some proximate principles of food experience an oxidation of certain of these constituents at the expense of the remainder, which consequently become deoxidised; and it is possible that some animal products may have undergone an entire deoxidation, or even several alternate deoxidations and reoxidations, before their final discharge from the body. On all these points very much yet remains to be learned; but still, the general position holds good, that vegetables effect a simultaneous deoxidation and intercombination of carbon molecules, while animals conversely effect their simultaneous reoxidation and separation. In many instances, also, the representatives of certain stages of building up and breaking up, in vegetable and animal life respectively, are closely allied to, or even identical with, one another. Oxalic acid, for instance, the simplest product of vegetable synthesis, and a frequent constituent of both the highest and lowest vegetable organisms, may be formed, as we have just seen, by a deoxidation of carbonic acid. But it also occurs abundantly in animal juices and secretions, not as a product of the deoxidation of carbonic acid, but as the last intermediate stage in the oxidation or downward transformation of more complex bodies into carbonic acid; just as the oxalic acid of commerce is obtained from sugar by a process of oxidation which, if carried too far, yields little else than carbonic acid. Benzoic acid, again, enjoys a wide distribution in the vegetable kingdom as a product of deoxidised carbonic acid, and is also a constant result of the natural and artificial oxidation of animal tissues. The power, then, of producing such bodies as benzoic acid and oxalic acid out of more complex bodies such as albumen and sugar, by artificial processes of oxidation more or less similar to the natural processes taking place in the animal body, has for a long time past been in the acknowledged possession of the chemist. Now, I propose to furnish you with illustrations of his inverse power, to which I have so often referred, of producing both animal and vegetable compounds by deoxidising, or synthetic, or vegetative processes—that is to say, of forming organic compounds without having recourse to living organisms or vital forces.

I will first give you an account of the general processes employed for passing from a more simple to a more complex group, and then of the particular processes by which certain individual substances have been produced, interspersing some remarks upon the nature and relationship of the substances themselves. At starting, let me recall to your recollection the associated series of homologous fatty acids and alcohols, as written up on the table before you:—

Alcohols.		Acids.	
$C\,H_4\,O$	Methylic.	$C\,H_2\,O_2$	Formic.
$C_2H_6\,O$	Ethylic.	$C_2H_4\,O_2$	Acetic.
$C_3H_8\,O$	Propylic.	$C_3H_6\,O_2$	Propionic.
$C_4H_{10}O$	Butylic.	$C_4H_8\,O_2$	Butyric.
$C_5H_{12}O$	Amylic.	$C_5H_{10}O_2$	Valeric.
$C_6H_{14}O$	Caprylic.	$C_6H_{12}O_2$	Caproic.
$C_7H_{16}O$	Anthylic.	$C_7H_{14}O_2$	Œnanthic.
$C_8H_{18}O$	Octylic.	$C_8H_{16}O_2$	Thetic.

Each of these alcohols and acids is, moreover, associated with a set of bodies having to it the same relations that ammonia, hydrochloric acid, and hydrogen have to water, as explained in my first lecture, and as shown below in the case of ordinary alcohol:—

Types.	Ethyl-derivatives.	
$H.H$	$C_2H_5.H$	Hydride of ethyl or ethene.
$H.Cl$	$C_2H_5\,Cl$	Chloride of ethyl, or chlorethine.
$H.HO$	$C_2H_5.HO$	Hydrate of ethyl, or alcohol.
$H.H_2N$	$C_2H_5.H_2N$	Amide of ethyl, or ethylamine.

Now, by a variety of processes, some new, some old, it is, and for a long time past has been, possible for us to fasten on to one or other of these or allied alcohol bodies an additional atom of carbon, in such a way as to produce the acid corresponding to the alcohol next in the series. Thus, by means of prussic acid CHN, or carbonic anhydride CO_2, or phosgene $COCl_2$, we can convert methylic alcohol into acetic acid, vinic alcohol into propionic acid, propylic alcohol into butyric acid, and so on; but until very lately we could not step from acetic to propionic acid, or from propionic to butyric acid,—that is to say, we could obtain butyric acid $C_4H_8O_2$, from certain members of the 3-carbon group, but not from those members which we had ourselves produced from the 2-carbon group; and, similarly, we could produce propionic acid $C_3H_6O_2$, from certain members of the 2-carbon group, but not from those members which we had ourselves produced from the 1-carbon group. The series of synthetic operations by which it would be possible to pass from any group not merely to the next, but to the next but one, and so on *ad libitum*, was incomplete through a want of knowledge of the metamorphic relation subsisting between the acid and alcohol of the same group. The alcohol, and not the acid, being the plastic member of the group, we could convert the 1-carbon alcohol into the 2-carbon acid, and the 2-carbon alcohol into the 3-carbon acid, and so on; but being unable to convert the 2-carbon acid into the 2-carbon alcohol, we could not by any means pass from the 1-carbon to the 3-carbon group. Very recently, however, this difficulty has been overcome by the separate researches of Wurtz and Mendius, who have shown us how to transform any acid into its corresponding alcohol; whereby a continuous series of synthetic processes may now be carried on as far as we please. Without entering into purely chemical details, I may say that the process of Wurtz consists in transforming the aldehyd of the acid into the normal form of the alcohol; while that of Mendius consists in transforming the nitrile of the acid into the ammoniated form of the alcohol, by means of nascent hydrogen, as illustrated below in the case of ethylic alcohol, thus:—

Aceto-nitrile.			Ethyl-amine.
$C_2H_3N + H_4$	$=$		C_2H_7N or $C_2H_5.H_2N$
Acet-aldehyd.			Ethyl-hydrate.
$C_2H_4O + H_2$	$=$		C_2H_6O or $C_2H_5.HO$
			Ethyl-chloride.
. . . . .			C_2H_5Cl or $C_2H_5.Cl$.

The amine is readily convertible into the hydrate, and the hydrate into the chloride, bromide, or iodide; which last bodies, or their metal derivatives—such, for example, as sodium-ethylate C_2H_5NaO, and sodium-ethyl C_2H_5Na—are the forms of alcohol most usually employed in actual synthetic processes. Prior, then, to this discovery by Wurtz and Mendius, of means for passing from the acid to its alcohol by hydrogenation, although many important syntheses had been effected, there had been no consecutive series of syntheses. The previously known processes would allow us to pass from certain mobile members of one group to certain immobile members of the next, but would carry us no further. Nowadays, however, by transforming the immobile acid into the mobile alcohol, we can proceed continuously through an apparently unlimited series of synthetic operations. Letting CO stand for the transferable part of carbonic anhydride CO_2, phosgene $COCl_2$, and hydrated prussic acid $CHN.H_2O$, we should have the following series of operations leading to the production of fatty acids and alcohols of any degree of complexity, each of them capable of metamorphosis into scores of allied compounds, which again are capable of entering into combination with one another, as explained in my second lecture, to form still more numerous and complicated bodies.

$$\text{1-Carbon alcohol}\quad \overset{\text{Methylic.}}{C\,H_4O} + CO = \overset{\text{Acetic.}}{C_2H_4O_2}.$$

$$\left\{\begin{array}{ll}\text{2-Carbon acid} & \overset{\text{Acetic.}}{C_2H_4O_2} + H_4 = H_2O + \overset{\text{Ethylic.}}{C_2H_6O}.\\ \text{2-Carbon alcohol} & \overset{\text{Ethylic.}}{C_2H_6O} + CO = \overset{\text{Propionic.}}{C_3H_6O_2}.\end{array}\right.$$

$$\left\{\begin{array}{ll}\text{3-Carbon acid} & \overset{\text{Propionic.}}{C_3H_6O_2} + H_4 = H_2O + \overset{\text{Propylic.}}{C_3H_8O}.\\ \text{3-Carbon alcohol} & \overset{\text{Propylic.}}{C_3H_8O} + CO = \overset{\text{Butyric.}}{C_4H_8O_2}.\end{array}\right.$$

$$\text{4-Carbon acid}\quad \overset{\text{Butyric.}}{C_4H_8O_2}, \text{ \&c., \&c.}$$

Starting from the 1-carbon or methylic alcohol, we can convert it into the 2-carbon or acetic acid by well-known processes. But in order to proceed from the 2-carbon acid, we must first transform it into the 2-carbon alcohol—the alcohol, in some or other of its forms, being the synthetic starting point, so to speak—and this we have very recently learned to do. Then, by affixing deoxidised carbonic anhydride on to the 2-carbon alcohol, we convert it into the 3-carbon or propionic acid. Then by acting upon propionic acid by deoxidised water, we transform it into propylic alcohol, upon which we again affix deoxidised carbonic anhydride to convert it into the 4-carbon or butyric acid, and so on continuously, by a series of deoxidising actions with carbonic oxide and hydrogen alternately.

Now let us proceed to notice briefly, in the order of their complexity, some of the more interesting organic or carbon compounds which have been produced artificially by elementary synthesis. Among mono-carbon compounds we have first carbonic acid CH_2O_3, alike the most important product of animal oxidation and subject of vegetable deoxidation. Associated with carbonic acid or hydrate, we have carbonic amide or urea CH_4N_2O, a body standing towards carbonic acid in the same relation that ammonia stands to water, and convertible into the acid by an exchange of certain elements of ammonia for the corresponding elements of water, thus:—

$$\overset{\text{Urea.}}{(CO)''H_4N_2} + \overset{\text{Water.}}{(H_2)H_2O_2} = \overset{\text{Ammonia.}}{(H_2)H_4N_2} + \overset{\text{Carbonic acid.}}{(CO)''H_2O_2}.$$

Carbonic acid is also met with in its dehydrated form as carbonic anhydride CO_2, and as the sulphur derivative of that body or carbonic sulphanhydride CS_2. These compounds are obtainable by burning charcoal in oxygen and sulphur respectively, the last of them, under the name of disulphide of carbon, being now produced on an enormous scale for certain manufacturing uses. The anhydride is readily procurable from the acid by dehydration, thus:—

$$\overset{\text{Carbonic acid.}}{CH_2O_3} - \overset{\text{Water.}}{H_2O} = \overset{\text{Carbonic anhyd.}}{CO_2};$$

and reconvertible into the acid or its salts by actual or potential rehydration, thus:—

$$\overset{\text{Carb. anhyd.}}{CO_2} + \overset{\text{Potash.}}{KHO} = \overset{\text{Potas. bicarb.}}{CKHO_3}, \text{ and } \overset{\text{Carb. anhyd.}}{CO_2} + \overset{\text{Lime.}}{Ca''O} = \overset{\text{Chalk.}}{CCa''O_3}.$$

The deoxidised forms of carbonic acid and anhydride, or formic acid CH_2O_2, and carbonic oxide CO, respectively, are readily procurable therefrom by processes of reduction, and are corralated with each other in a similar manner, thus:—

$$\overset{\text{Carb. oxide.}}{CO} + \overset{\text{Potash.}}{KHO} = \overset{\text{Potas. formiate.}}{CKHO_2}, \text{ and } \overset{\text{Formic acid.}}{CH_2O_2} - \overset{\text{Water.}}{H_2O} = \overset{\text{Carb. oxide.}}{CO}.$$

The production of formic acid or formiates by the reduction of carbonic acid with sodium (Kolbe), and by the combination of potash with carbonic oxide (Berthelot), being among the early examples of the formation of organic from inorganic compounds, excited on their first announcement a large amount of chemical interest. Altogether, formic acid enjoys a very extensive natural distribution. In the vegetable kingdom it occurs in the juice of the stinging nettle, in decaying pine needles, and as a product of the spontaneous oxidation of turpentine. In the animal kingdom it has been occasionally recognised in human blood, urine, perspiration, and in the fluids of the spleen and muscles. It also exists largely in the juice of red ants from which it may be obtained by simple distillation, and in the corrosive fluid of certain caterpillars, &c. Now, by combining formic acid with ammonia, we obtain formiate of ammonia, which yields by dehydration that important organic compound met with in cherry-laurel water, bitter almond emulsion, &c., and known as prussic acid or cyanide of hydrogen, thus:—

$$\overset{\text{Formic acid.}}{CH_2O_2} + \overset{\text{Ammonia.}}{H_3N} - \overset{\text{Water.}}{2H_2O} = \overset{\text{Prussic acid.}}{CHN}.$$

Moreover, this acid or a corresponding cyanide may nowadays be procured, not only from formic acid, but by the direct combination of carbon, nitrogen, and a metal. Again, by oxidising a cyanide—that of potassium CKN, for instance—we obtain cyanate of potassium CKNO, convertible by double decomposition into cyanate of ammonia, which changes spontaneously into urea, thus:

$$\overset{\text{Ammon. cyanate.}}{CHNO.H_3N} = \overset{\text{Urea.}}{CH_4N_2O}.$$

This is the celebrated reaction by which urea was first produced artificially by Wöhler in 1828; but at that time the cyanogen of the cyanide of potassium employed was known only as a product of organic origin. You observe that by oxidising formic acid we obtain carbonic acid; and by oxidising the mon-ammoniated form of formic acid—namely, prussic acid—in presence of more ammonia, we obtain the di-ammoniated form of carbonic acid—namely, urea, which has since been produced by several other artificial processes.

The still less oxidised monocarbon compounds belong to the methyl sub-group, and are, principally—

Methyl compounds.

$$\left\{\begin{array}{lll}CH_4 & \text{or } CH_3.H & \text{Methyl hydride or marsh gas.}\\ CH_3Cl & \text{or } CH_3.Cl & \text{Methyl-chloride.}\end{array}\right.$$

$$\begin{array}{lll}CH_4O & \text{or } CH_3.HO & \text{Methyl-hydrate or wood spirit.}\\ CH_5N & \text{or } CH_3H._2N & \text{Methyl-amine.}\end{array}$$

These four bodies—the methyl varieties of hydrogen, hydrochloric acid, water, and ammonia—are mutually convertible by a variety of processes. Marsh gas, in addition to its occurrence as the chief constituent of coal gas, as the fire damp of coal mines, and as the gas of stagnant ponds or marshes, has recently been recognised by Pettenkofer as a normal ingredient of expired air. Wood spirit, again, is not only a product of destructive distillation, but occurs in nature as a constituent residue of the essential oil of wintergreen, thus:—

$$\overset{\text{Wintergreen oil.}}{C_8H_8O_3} + \overset{\text{Water.}}{H_2O} = \overset{\text{Salicic acid.}}{C_7H_6O_3} + \overset{\text{Wood spirit.}}{CH_4O}$$

Among other well known methyl compounds may be mentioned sarcosine, kreatine, caffeine or theine, theobromine, coniine, narcotine, &c., &c. The production of methylic from carbonic or formic compounds may be effected in a variety of ways. Thus prussic acid, by hydrogenation, yields methylamine:—

$$\overset{\text{Prussic acid.}}{CHN} + \overset{\text{Hydrogen.}}{H_4} = \overset{\text{Methylamine.}}{CH_5N}$$

Formiate of barium is decomposed by heat with production of marsh gas; thus:—

$$\overset{\text{Barium formiate.}}{2\left\{\begin{matrix}CH\\CH\end{matrix}Ba''\begin{matrix}O_2\\O_2\end{matrix}\right.} = \overset{\text{Barium carb.}}{2CBa''O_3} + \overset{\text{Carb. anhyd.}}{CO_2} + \overset{\text{Marsh gas.}}{CH_4}$$

Marsh gas also results from passing a mixture of carbonic sulphanhydride and sulphuretted hydrogen over metallic copper heated to redness, thus:—

$$\overset{\text{Carb. sulph.}}{CS_2} + \overset{\text{Hyd. sulph.}}{2H_2S} + \overset{\text{Copper.}}{Cu_8} = \overset{\text{Cupr. sulph.}}{4Cu_2S} + \overset{\text{Marsh gas.}}{CH_4}$$

Perhaps a still more interesting mode of obtaining methyl compounds consists in submitting disulphide of carbon to prolonged treatment with chlorine gas, whereby it is converted into perchloride of carbon, which by the continuous action of nascent hydrogen yields the following series of compounds:—

Marsh-gas Derivatives.

CCl_4	Perchloride of carbon.
$CHCl_3$	Chloroform.
CH_2Cl_2	Dichloromethene.
CH_3Cl	Chloride of methyl.
CH_4	Methene, or marsh-gas.

Thus among monocarbon compounds of purely artificial production we have the following interesting bodies, of which all save the last occur naturally in the vegetable or animal kingdom—namely, urea, formic acid, prussic acid, methylamine, marsh gas, and chloroform.

The principal members of the dicarbon group, namely, alcohol and acetic acid, together with their respective congeners, are procurable from monocarbon compounds by a variety of processes. Thus, according to some observations of my own, on submitting a mixture of marsh-gas and carbonic oxide to a full red heat, acetylene or klumene is produced thus,—

Marsh-gas. Carb. oxide. Water. Klumene.

$$CH_4 + CO = H_2O + C_2H_2;$$

and this klumene, when acted upon by nascent hydrogen, yields olefiant gas, or ethylene, thus:—

Klumene. Hydrogen. Ethylene.

$$C_2H_2 + H_2 = C_2H_4$$

Now, olefiant gas, as pointed out by Faraday and Hennell nearly fifty years ago, and as rediscovered and established beyond question by Berthelot within the last few years, is absorbed by oil of vitriol, and upon distilling the diluted acid, is liberated therefrom in the form of alcohol or spirit of wine, thus:—

Ethylene. Water. Alcohol.

$$C_2H_4 + H_2O = C_2H_6O.$$

This production of alcohol from olefiant gas, or ethylene, an important constituent of ordinary coal gas, is undoubtedly, in many points of view, a result of very great interest, but as a step in organic synthesis I think its importance has been somewhat over-estimated—alcohol and olefiant gas being closely allied members of the same carbon group. However, Berthelot's discovery of a process for obtaining alcohol by purely inorganic means naturally achieved considerable notoriety, and gave a great impetus to the general prosecution of synthetic methods. You observe that the alcohol is produced from olefiant gas, which is itself produced from acetylene or klumene, which is itself produced from monocarbon compounds of strictly mineral origin. But a still more interesting way of obtaining acetylene has also been rediscovered and established by Berthelot, namely, the combustion, so to speak, of carbon in hydrogen gas. When charcoal is burnt in oxygen, the heat evolved by the initial combination is more than sufficient to maintain the combustion, and accordingly the piece of charcoal when once ignited continues to burn. But in the combustion of charcoal in hydrogen, if it may so be called, the piece of charcoal has to be maintained throughout in an intense state of ignition by means of the electric arc. When, for instance, the charcoal terminals of a moderately powerful battery, enclosed in a globe through which a current of dry hydrogen is passing, are approximated to each other so as to become ignited, as in the ordinary electric lamp, the hydrogen and ignited carbon combine with one another to form hydride of carbon or acetylene, much in the same way that oxygen and ignited carbon combine with one another to form oxide of carbon or carbanhydride. But oxidation tends to the separation, hydrogenation to the conjunction of carbon atoms; and accordingly, by the combustion of charcoal in oxygen we obtain only the mono-carbon compound CO_2, whereas by its combustion in hydrogen we obtain the dicarbon compound C_2H_2, which is separated from the excess of hydrogen by transmission through an ammoniacal solution of the white or inferior chloride of copper, whereby it is retained in the form of cuprous acetylide C_2HCu. This compound is thrown down as an abundant bright red precipitate, and, by treatment with warm hydrochloric acid, is decomposed with liberation of acetylene gas, thus:—

Cupr-Acetylide. Chlorhyd. acid. Cuprous chlor. Acetylene.

$$C_2HCu + HCl = CuCl + C_2H_2$$

Acetylene is characterised by the extreme luminosity with which it burns. You observe the great opacity and whiteness of its flame, and the large amount of light afforded by it in proportion to its bulk, when compared, for instance, with the flame of ordinary coal gas, of which, indeed, acetylene is a constituent, though only to a small extent. Upon hydrogenising his cuprous acetylide by means of zinc and ammonia, Berthelot produced olefiant gas, from which, by indirect hydration with sulphuric acid, he afterwards obtained alcohol, as I have already described. Now, among other animal products, alcohol occurs as a residue of tyrosine, a compound to which I shall refer more particularly in my next lecture; also in triethylamine, a constituent of the brine in which herrings and other fish have been pickled; and, as I have before observed, in taurine, which is producible in the following manner:—Under certain circumstances, the residues of alcohol and sulphuric acid combine with one another to form isethionic acid, easily convertible into chlorethyl sulphurous acid $C_2H_4ClSO_3$, by means of pentachloride of phosphorus. This chloride is retransformable into its hydrate or isethionic acid $C_2H_4(HO)SO_3$, by the action of water, while both the chloride and the hydrate are transformable into the amide or taurine $C_2H_4(H_2N)SO_3$,* by means of of ammonia, according to the following reactions, the first of them due to Kolbe, the second, which is earliest in point of time, to Strecker:—

Chloride & Hydrate. Taurine or Amide.

$$C_2H_4ClSO_3 + H(H_2N) = HCl + C_2H_4(H_2N)SO_3$$
$$C_2H_4(HO)SO_3 + H(H_2N) = H_2O + C_2H_4(H_2N)SO_3$$

Now, alcohol is procurable from acetic acid by the hydrogenising processes of Wurtz and Mendius, already described; while acetic acid is reprocurable from alcohol by oxidation, as in the ordinary manufacture of vinegar. Moreover, acetic acid $C_2H_4O_2$, may be obtained synthetically from methyl alcohol CH_4O, by fixation of carbonic oxide CO, according to the previously mentioned general methods; and also from disulphide of carbon by Kolbe's historic process, referred to in my last lecture. The successive stages of this, the earliest unimpeachable process for obtaining an organic compound by strictly mineral means, are as follows:—Disulphide of carbon CS_2, is first obtained by the combustion of charcoal in sulphur vapour. When this compound is acted upon by chlorine at a high temperature, it is converted into chloride of sulphur and chloride of carbon CCl_4. Now, by transmission through red-hot tubes, this last compound is transformed, with evolution of chlorine, into the so-called sesquichloride of carbon, $2CCl_4 = Cl_2 + C_2Cl_6$, and eventually into the so-called bichloride of carbon or tetrachlorethylene, $C_2Cl_6 = Cl_2 + C_2Cl_4$. In the course of his examination of this tetrachlorethylene, Kolbe observed that by exposure to chlorine in presence of water, it was decomposed into a mixture of trichleracetic and hydrochloric acid, thus:—

Chlor-ethylene. Water. Chlorine. Chlorhyd. acid. Chlor-acet. acid.

$$C_2Cl_4 + 2H_2O + Cl_2 = 3HCl + C_2HCl_3O_2$$

Then by subjecting this trichlor-acetic acid to the action of nascent hydrogen, he successively converted it into dichlor-acetic acid $C_2H_2Cl_2O_2$, monochlor-acetic acid $C_2H_3ClO_2$, and finally into normal acetic acid $C_2H_4O_2$,

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* These formulæ are not meant to express the assumed internal molecular arrangement of the three bodies, but only their positively ascertained mutual relationship.

which thus resulted from the series of transformations indicated in the table before you :—

Acetic Acid Synthesis.

CS_2	Carbon disulphide.
CCl_4	Carbon tetrachloride.
C_2Cl_4	Tetrachlor-ethylene.
$C_2HCl_3O_2$	Trichlor-acetic acid.
$C_2H_4O_2$	Acetic acid.

The disulphide of carbon, produced by the direct combination of sulphur and carbon, is converted, by treatment with chlorine, into tetrachloride of carbon; this, by heating to redness, into tetrachlor-ethylene; this, by the action of moist chlorine, into trichlor-acetic acid; and this, by means of nascent hydrogen, into ordinary acetic acid. By arresting the hydrogenation at a certain point, and treating the so-formed monochlor-acetic acid $C_2H_3ClO_2$, with ammonia, we obtain glycocine, whereas by treating it with methylamine we obtain sarcosine, which, in combination with urea, constitutes kreatine, a compound, however, that has not yet been obtained artificially.

Thus, among 2-carbon products of the animal and vegetable kingdom, that have been obtained by strictly mineral processes, may be mentioned alcohol, triethylamine, taurine, acetic acid, glycocine, sarcosine, and last, though not least important, oxalic acid; which results from the oxidation of alcohol, acetic acid, and glycolic acid, &c., and is producible synthetically from the mono-carbon formic and carbonic acids.

By means of the general processes to which I directed your attention some time back, as well as by certain special processes, it is easy to pass from the 2-carbon to the 3-carbon group, upon which, however, we must rest satisfied with bestowing a very cursory glance. It comprises among its members glycerine $C_3H_8O_3$, the basic principle of the true fats, whether of vegetable or animal origin. Also lactic acid $C_3H_6O_3$, an important constituent of the juice of flesh, and a product of that fermentation of grape-sugar and milk-sugar which is set up by putrefying curd. We have also the chief constituents of essential oil of garlic or allyl-sulphide $(C_3H_5)_2S$, and of essential oil of mustard or allyl-sulphocyanate $(C_3H_5)HCNS$, to be included in the list of artificially-produced members of the propionic family.

Passing on to the 4-carbon group, we have first butyric acid $C_4H_8O_2$, a product of the destructive metamorphosis of sugar, mannite, &c. Combined with alcohol it forms butyric ether or essential oil of pine-apple, while combined with glycerine it forms that constituent of ordinary butter which is known as butyrine. Butyric is readily convertible into succinic acid $C_4H_6O_4$, which bears to it the same relation that oxalic bears to acetic acid, and probably the most frequent artificial product of the oxidation of fatty matters. From succinic acid it is easy to procure in succession the well-known vegetable products, malic acid $C_4H_6O_5$, and tartaric acid $C_4H_6O_6$. The succinic and malic acids are very intimately associated with, and readily convertible into, one another. Thus asparagine $C_4H_8N_2O_3$, the crystalline principle of asparagus and other etiolated plants, yields one or other of these acids, according to the treatment to which it is subjected.

The 5-carbon compounds of artificial origin are of less general interest. I may mention fousel oil or amyl-alcohol $C_5H_{12}O$, and valeric or valerianic acid $C_5H_{10}O_2$, a product originally obtained from essential oil of valerian. By combining amyl-alcohol with acetic acid we procure the pear flavour, and by combining it with valeric acid the apple or quince flavour used in confectionery, which are probably identical with the essential oils existing in the ripe fruits. Again, by combining valeric acid with glycerine we produce valerine, a constituent of whale oil.

Of the 6-carbon fatty compounds which have been artificially obtained, the most interesting are caproic acid $C_6H_{12}O_2$, and leucic acid $C_6H_{12}O_3$. Caproic acid is met with as a glyceride in goat's butter, while amido-caproic acid or leucine is an occasional constituent of human urine, and a constant product of the metamorphosis of glandular tissue. Grape sugar $C_6H_{12}O_6$, mannite $C_6H_{14}O_6$, and a host of allied alimentary substances are also included in this group, though their exact relationship to the typical members is not as yet clearly established. Now, sugar has been obtained by Berthelot from glycerine, which is itself, as I have said, obtainable by purely inorganic means; so that, in one sense, sugar may be added to the list of artificially produced organic compounds. Still the means employed for effecting the conversion of the glycerine—namely, the action of putrifying animal tissue—must prevent our regarding the resultant sugar as being strictly of inorganic origin; although it is formed exclusively out of the glycerine, the animal tissue not contributing any actual material to its formation. However, if sugar has not yet been obtained by a satisfactory process, the recent formation of strictly allied bodies, such as the propylphycite of Carius, together with our increasing knowledge of the metamorphic relations of sugar itself, assures us that an unexceptionable means for producing this important alimentary principle cannot much longer escape us.

The transformation of fatty into aromatic compounds has not yet been accomplished according to any definite reaction; but both phenene C_6H_6, and phenol or carbolic acid C_6H_6O, are producible by transmitting the vapour of alcohol or fousel oil through red-hot tubes. From the former of these bodies we readily obtain aniline or phenylamine C_6H_7N, which is reconvertible into both phenene and phenol.

The 7-carbon fatty acid and alcohol are usually obtained from castor oil. So far as I know, they have not been produced artificially from inorganic materials, but undoubtedly could be so produced at any moment. With the 7-carbon aromatic compounds the case is different. By the general processes already referred to, phenene has been converted into benzoic acid $C_7H_6O_2$, by Harnitzky and Kekulé, and phenol into salicic acid $C_7H_6O_3$, by Kolbe. Benzoic acid readily yields benzoic aldehyd or essential oil of bitter almonds, and also glyco-benzoic or hippuric acid. Salicic acid, again, is readily oxidisable into gallic acid, of which tannin constitutes the natural glucoside, as shown by the following decomposition :—

$$\underset{\text{Tannin.}}{C_{27}H_{22}O_{17}} + \underset{\text{Water.}}{3H_2O} = \underset{\text{Glucose.}}{C_6H_{12}O_6} + \underset{\text{Gallic acid.}}{3C_7H_6O_5}$$

From salicic acid we may also obtain methylsalicate or essential oil of wintergreen, salicic aldehyd or essential oil of spirea, and saligenine or salicylic alcohol, a compound frequently mentioned in my second lecture as a constituent residue of salicine and populine—salicine being, indeed, a glucoside of saligenine, much in the same way that tannin is a glucoside of gallic acid, thus :—

$$\underset{\text{Salicine.}}{C_{13}H_{18}O_7} + \underset{\text{Water.}}{H_2O} = \underset{\text{Glucose.}}{C_6H_{12}O_6} + \underset{\text{Saligenine.}}{C_7H_8O_2}.$$

Moreover, tyrosine,—a very remarkable product of tissue metamorphosis—though not yet produced from salicic acid, has much the same relation thereto that leucine has to caproic, and sarcosine and glycocine have to acetic acid, being, indeed, the ethyl-ammoniated form of salicic acid.

Another 7-carbon compound of artificial production, and of great interest in an industrial point of view, is benzoene, or toluol C_7H_8, which Fittig and Tollens have recently obtained from phenene or benzol C_6H_6. Starting from these two bodies, we may procure all the so-called coal-tar colours, with the brilliancy and variety of which most of us are now familiar. The red base or rosaniline $C_{20}H_{19}N_3$, the violet base or triethylrosaniline $C_{26}H_{31}N_3$, and the blue base or triphenylrosaniline $C_{38}H_{31}N_3$, being producible in this way from their constituent elements, furnish admirable illustrations of the constructive powers of modern organic chemistry.

Thus have I illustrated to you the mode in which chemists can nowadays, without any recourse to vitality, build up primary molecules containing as many as seven atoms of carbon, either from carbonic acid, water, and ammonia, the materials out of which living organisms construct identical or similar molecules, or else from the elementary substances, carbon, hydrogen, oxygen, and nitrogen, upon which living organisms can exert no plastic action whatever. I might even proceed further, but should then be obliged to depart from that regular sequence I have hitherto followed. Moreover, my object has been rather to illustrate to you the general mode of procedure than to make known to you the utmost limits that have as yet been attained. Of the three great classes of alimentary substances, the oleaginous are quite, and the saccharine almost within our reach. The albuminous, indeed, are still far beyond us; and no wonder, since their very constitution is at present not only unknown, but unsuspected. In their case, however, as in that of many other bodies, so soon as we succeed in unravelling the mystery of their natural composition, so soon may we aspire confidently to the work of their artificial reconstruction.

Only a few words more, which I will borrow from my friend Dr. Frankland. "It would be difficult," said he. "to conclude a subject like the present without some notice of the considerations which naturally suggest themselves regarding the possibility of *economically* replacing natural processes by artificial ones in the formation of organic compounds. At present, the possibility of doing this only attains to probability in the case of rare and exceptional products of animal and vegetable life. By no processes at present known could we produce sugar, glycerine, or alcohol from their elements at one hundred times their present cost, as obtained through the agency of vitality. But, although our present prospects of rivalling vital processes in the economic production of staple organic compounds, such as those constituting the food of man, are exceedingly slight, yet it would be rash to pronounce their ultimate realisation impossible. It must be remembered that this branch of chemistry is as yet in its merest infancy; that it has hitherto attracted the attention of but few minds; and further, that many analogous substitutes of artificial for natural processes have been achieved. . . . . In such cases where contemporaneous natural agencies have been superseded, we have almost invariably drawn upon that grand store of force collected by the plants of bygone ages and conserved in our coal-fields."

ACADEMY OF SCIENCES.

August 21.

M. Damour presented a memoir "*On the Chemical Composition of the Stone Implements of Pre-historic Times.*" In this first part of the memoir the author gives a very good account of quartz, agate, flint, jaspar, obsidian, and fibrolite, all well-known substances that have been employed in the manufacture of stone implements. The account of the examination of the implements is to come, we suppose, in the next part.

M. Cloëz contributed a second memoir "*On the Oxidation of Fatty Vegetable Oils.*" In this memoir he treats of the influence of light and heat on the oxidation. The author's results are of much interest. He exposed oils to the air in colourless glass vessels, and also in vessels of red, yellow, green, and blue glass, and also left some oil exposed to air in total darkness. After ten days' exposure the increase of weight was greatest in the colourless glass vessel; it was rather less in the blue glass; was very small in the red, yellow, and green; and no increase of weight at all was observed in the oil exposed in the dark. Like results were found after twenty days; but after thirty days' exposure the results were somewhat different. The increase of weight was greater in the coloured glasses than in the uncoloured, green showing the largest increase after 150 days' exposure. It is worthy of notice that poppy oil, after a time, oxidised faster in the dark than when exposed to coloured or white light. Oil heated in atmospheric air oxidised much more rapidly than cold oil. The oxidation may be accelerated without heat by adding some oil already oxidised.

M. Blomstrand presented a "*Note on the Metals of the Tantalum Group.*" According to the author, only two metals exist in this group, Niobium and Tantalum. The acids also are only two in number, di- or tetratomic: tantalic acid TaO_2 or $\bar{T}a\Theta_2$ and niobic acid NbO_2 or $\bar{N}b\Theta_2$. Rose's white hyponiobic chloride is an oxychloride, $Nb_4Cl_6O_3$ or the double. Hyponiobic acid prepared by the decomposition of the oxychloride is true niobic acid, NbO_2. Kobell's dianic acid is, without doubt, niobic acid, either pure or perhaps mixed with a little tantalic acid, too small in quantity to interfere with the reaction with tin which Kobell considered characteristic of dianium, and which is also common to niobium. The author criticises M. Marignac's paper on the hyponiobic compounds, suggesting that the material M. Marignac experimented with was not pure, tantalum being present with the niobium. As we recently mentioned, Blomstrand has fixed the equivalent of true niobium at 39 ($\bar{N}b = 78$).

Two other papers we may dispose of very shortly. M. Pécholier writes, that the reason *absinthe* produces worse effects than other alcoholic drinks of equal strength is, that the liquor is usually taken on an empty stomach.

M. Donnet has made a *microscopic examination of rotten eggs*, to ascertain whether the putrefaction was caused by, or developed, infusoria. He found no trace of organisms at any stage of the putrefaction. This is an important fact for the opponents of spontaneous generation.

NOTICES OF BOOKS.

Diamonds and Precious Stones: their History, Value, and Distinguishing Characteristics: with Simple Tests for their Identification. By Harry Emanuel, F.R.G.S. London: Hotten. 1865.

A complete account of diamonds and precious stones in relation to chemistry, geology, art, morals, and political economy, would form one of the most interesting books ever written. The author of the work under notice does not pretend to anything so ambitious as this, and yet has produced a book of very considerable value. The scientific account of the several stones, indeed, is in most cases imperfect, and in many inexact; art is scarcely noticed, and the special history is, we fear, not always to be relied upon; but, in spite of this, the general reader will find much that is novel and interesting, and those who wish for commercial information much that is valuable.

Diamonds and precious stones have in all ages possessed a high exchangeable value—not entirely, it would seem, from their rarity. Ancient superstitions ascribed to certain stones occult virtues which modern intelligence would appear to not altogether discredit. The author of this work, in his evidence in the case Emanuel *v.* Wilbraham, said that it was customary in these days for a gentleman when engaged to present his *fiancée* with three rings, an emerald, a ruby, and a diamond. These, which would at first sight appear merely as offerings to the lady's vanity, may perhaps have another signification. For we learn from this and other books that the emerald was regarded as preservative of female chastity, while the ruby was supposed to ward off evil company and unpleasant dreams, and the diamond was potent against all sorts of poisons. Potent or not, diamonds and rubies are now of more value than they ever were, and, as the author hopes in his preface, this book "will prove useful to the merchant in supplying him without trouble with the distinguishing characteristics of each gem, and to the amateur as affording him simple and easy means of distinguishing the false from the real, and the valuable from the worthless."

But to distinguish the false from the real is not always so easy, as the following story, which we will quote for the amusement of our readers, will show:—

"A noble lady in this country formerly possessed one (a sapphire), which is, perhaps, the finest known. The lady, however, sold it during her lifetime, and replaced it by an imitation so skilfully made as to deceive even the jeweller who valued it for probate duty; and it was estimated at the value of 10,000*l*., and the legacy duty paid on it by the legatee, who was doubtless chagrined when he discovered the deception." We should think he was; and it may moderate the transports of some who see gorgeous displays of jewellery to be informed that a handsomely printed circular in our possession informs ladies who have occasion to part with their jewels for a time that imitations which defy detection will be supplied at a certain establishment on short notice, adding that "perfect confidence and the utmost secrecy may be relied on."

But it is time that we betook ourselves to the scientific contents of this book. We may pass over the chapters "On the Ideas of the Ancients Respecting Precious Gems," and "On the Precious Stones Mentioned in the Bible," which will have great interest for the general reader, and come at once to the account of the diamond, which is, as it ought to be, one of the best in the book. In this we find mentioned a form of the diamond which is not described in chemical books; it is here called "carbonate, or diamond carbon." It is found in the province of Bahia, and occurs in sandstone apparently of the same era as the gneiss and syenite rocks of Norway and Greenland. "Its hardness is identical with that of the diamond, and its specific gravity from 3·012 to 3·416; some specimens show an imperfect crystalline structure of a brownish-green, opaque colour; others of a granular structure, porous enough to resemble pumice-stone, dense, very massive, and found sometimes in lumps as large as a walnut. It is extremely hard, in some cases taking a polish equal to diamond, and appears to be carbon imperfectly crystallised; when burnt, it leaves a residue of clay and some other substances. . . . This substance would appear to be the connecting-link between uncrystallised carbon and the diamond, and a scientific examination of it might lead to important results."

There would appear to be another uncrystallised form of the diamond known as "Boart." Both this and the former are crushed to powder, and used for cutting and polishing other diamonds, rubies, &c.

The account of the method of splitting, cutting, and polishing diamonds is very good; and here we meet with a description of the "brilliant," the fashionable form of the present day. "The general form of the rough diamond is of two pyramids joined at the base; if a diamond is not of this form it must be made so by art; and in order to produce the table there must be taken away from the upper pyramid five-eighteenths, and from the lower one-eighteenth of the total thickness. The upper or flat part is called the table, and from thence to the girdle or centre edge and broadest part of the stone are facets, called star facets; from the girdle to the lower or pointed part, called the culet, and which is nearly pointed, are facets, called skill facets. These facets meet in the middle of each side of the table and girdle, and also at the corners, forming regular lozenges on the four upper sides or corners of the stone. The triangular facets on the under side of the culet to the girdle must be half as deep again as the upper or star facets. The thickness of the stone should be in this proportion:—From the table to the girdle, one-third; and the girdle to the culet, two-thirds of the total thickness; the diameter of the table, four-ninths of that of the girdle; the culet one-fifth of the table. The girdle of the stone should be of the same dimensions as the thickness or depth. A stone, if well cut, should have a very thin edge at the girdle; and any overweight or substance retained to make a diamond heavier only detracts from its play or beauty."

A stone so cut and proportioned, and free from flaws, will at the present day, if of one carat (= 4 grains), be worth 18*l*.; but if of five carats weight it will fetch 320*l*. In 1750 a diamond of five carats would, according to Jeffrey, have been worth 200*l*. "The value of stones above five carats is not attempted to be given, as it is impossible to fix it with accuracy, this depending entirely on the demand for any particular size and the supply in the market." Rose-cut stones fetch at the present day rather less than brilliants.

Of the other precious stones we need not speak. The chemistry of them will be well known to our readers, but they will find much interesting matter relating to them in Mr. Emanuel's book.

In an appendix to the book the reader will find a tolerably complete list of works relating to gems; but we notice that neither here nor in the body of the book has the author referred to the experiments of Ebelmen, Deville, Troost, and others, on the artificial formation of precious stones. This may be politic in a jeweller, since the writers referred to suggest a day not far distant, when, at all events, rubies, sapphires, and amethysts may be produced at will. The day pleasantly imagined by Alphonse Karr, when a philosopher shall exhibit at the Academy of Sciences a diamond as big as his fist, and apologise for the smallness of the specimen, may still be distant, but nearer, perhaps, than is generally supposed.

CORRESPONDENCE.

Continental Science.

PARIS, August 26.

IN the absence of any chemical or technical information worth notice, nothing, perhaps, will have more interest for the readers of the CHEMICAL NEWS than an account of the various remedies for the cholera which the fear of an approaching outbreak has brought to notice. It will be unnecessary to preface the mention of these with any remarks on their probable efficiency. They come before the world stamped with the authority of their writers, medical men, who profess, in each instance, to have proved the value of the remedy recommended, and it will be for your medical readers to decide whether they will put the remedies to the test or leave their patients to Providence.

The first I may mention is that which Dr. Ponowski, of St. Petersburg, has published. It is powdered hellebore, veratrum album, I suppose taken by the nose, like snuff. This is an infallible remedy when the patient sneezes eight or ten times after a pinch; but if the patient does not sneeze his case is altogether hopeless.

The next thing I may mention is much more valuable, since a preventative is better than a cure. Dr. Burq has noticed that workmen employed on copper are never attacked with cholera, and he accordingly suggests the employment of this metal as a prophylactic against, and as a remedy in case of an attack. With the first object, he applies the metal externally, in the form of a girdle constructed of thin plates of copper, fixed at short intervals on an elastic band, so that they may be easily fixed round the body. The metal must of course be in contact with the skin, and the Doctor leaves it there until a considerable amount of verdigris is formed, which must not be disturbed; hence, he says, the wearer must bathe as little as possible. A copper bandage, however, is troublesome, and sometimes, Dr. Burq says, brings out an eruption, and even causes sickness. Should either happen the bandage may be discontinued and an ointment of verdigris, extract of belladonna, and lard, rubbed under the armpits and inside the thighs every night; or, instead of this, bathing in a solution of sulphate of copper every other day might do. Besides using this girdle, it will be well to imbibe once a day, or even twice if the epidemic is very prevalent, small doses of acetate of copper, with a little opium. In case of an attack, the author would use all these methods together, and lavements of sulphate of copper as well.

Another remedy suggested is carbonic acid, which is to be injected into the veins.

A fourth writer, whose name also escapes me, has written to recommend frictional electricity. He would insulate the patient, and take sparks all down the spine and from the pit of the stomach.

Lastly, M. Surviron proposes to destroy at once the means of infection by producing ozone continuously on a large scale; but the Academy has been wicked enough to keep the author's method of getting ozone on a large scale to themselves.

MISCELLANEOUS.

British Association.—It is hardly necessary to remind our readers that the annual meeting at Birmingham commences on the 6th of this month. The chemical section will meet in the English School, King Edward's School—President: Professor W. A. Miller, M.D., F.R.S., &c.; Secretaries: A. Vernon Harcourt, Esq., M.A., F.C.S.; Professor Wanklyn, F.C.S.; H. Adkins, Esq.; and A. Winkler Wills, Esq. We shall give full reports of the proceedings of this section. Authors wishing their papers to be published at length are requested to forward them as early as possible.

British Pharmaceutical Conference.—The meeting for the present year will be held at Birmingham, at the Odd Fellows' Hall, Temple Street. It will commence on Tuesday, the 5th September, at 10 a.m., and be continued on Wednesday, the 6th, at the same hour, and on Thursday and Friday, 7th and 8th September, at seven o'clock in the evening. Many interesting papers on Pharmaceutical subjects are already promised, and others will, doubtless, be sent in. A large gathering of members is expected.

A Rival for the Magnesium Light.—Mr. Jas. Wilkinson, of Chelsea, has invented a composition of phosphorus, nitrate of potash, and "five other powders," which, when burnt, gives a light sufficiently bright to produce very sharp photographic pictures.

Telluride of Copper.—We must add to our report of M. Becquerel's memoir, at page 57, the remark of the author that telluride of copper is a much more powerful thermo-electric element than sulphide of copper.

Agglutinative Tissue.—Dr. Fort (*Rep. de Pharm.*) suggests as a substitute for the English isinglass plaster, a tissue made as follows:—Take of gum arabic, selected, 5 drachms; distilled water, 8 drachms; glycerin, a sufficient quantity. Dissolve the gum in the water, and add sufficient glycerin to render the mucilage of the consistence of syrup. This solution is spread by means of a brush on one side of thin glazed muslin. The author suggests this plaster as inodorous, very supple, and as not cracking in winter, owing to the glycerin in its composition. It adheres strongly by simply moistening the surface, and can be easily removed. The author does not say whether it is hygroscopic, or ill adapted for a damp atmosphere.—*Am. Jour. of Pharm.*

Accidental Poisoning.—Mr. Noakes, a highly respectable chemist at Brighton, has been committed to take his trial for causing the death of a customer by dispensing tincture of aconite instead of tincture of henbane. If there can be any consolation under such circumstances, it might be found in the circumstance that the victim in this case was a gentleman, aged 81, suffering from a disease which was likely to terminate his life naturally in the course of a few days. It is worthy of remark that the mistake was made by the principal of the establishment, a man of very high character, and who could not be supposed to be insensible to his own interests, and not by an assistant or apprentice. Upon this matter we may quote with approval the following remarks from the *Standard*:—"There is no more serious matter for contemplation than medical 'poisoning by mistake,' for if the lives of the sick and the infirm are at the disposal of one person more than another, that person is the chemist and druggist. The physician prescribes, but the chemist compounds; and so great is the confidence of patients and their friends in his skill and businesslike correctness, that the drug or the mixture is swallowed fearlessly, and with only the wry face that is as natural to medicine taking as a long face is said to be to grief. Most of us are, at one time or another, in the hands of the skilled tradesman with the bottles of tinted glass and the illuminated and mysterious diploma in his window, and when the phial comes from his shop we drink from it in perfect reliance on the compound being correctly 'made up,' and those minute quantities represented by grains and scruples being just to a particle. It is, indeed, upon this strong confidence placed in him, his education, and his diploma, that the druggist exists as the middleman between the doctor and the patient. He may know nothing of the ailment his drugs are expected to alleviate, nor of the disease they may be asked to cure. He has before him the cabalistic signs, the abbreviated dog Latin of the profession, and he silently obeys the cabala with a neatness of hand and a general coolness of aspect peculiar to the calm and strangely-perfumed region in which his business is transacted. Habit, perhaps, makes the druggist a trifle too cool and confident in some cases. He appears to know his jars and bottles by the touch, just as the compositor mechanically selects from the frame before him the right letter and puts it in the right place with what ordinary observers look upon as comparative inattention. With the apothecary's weights and measures the same cool certainty appears to prevail, and when the phial being filled or the pills made up he neatly envelopes the bottle or the box in fair white paper, seals it, and passes it over the counter, it often occurs to the recipient what a clean, steady, firm-handed gentleman the chemist and druggist is, and how well he answers to the great trust reposed in him. Not unfrequently he has to 'make up' something from oral instruction, or even from the lights afforded him by an old inscription on a phial. And this he does with the same neatness, the same confidence in his handling of the drugs, and with the invariable characteristic cleanliness of his craft. Now, let it be considered that this apothecary has life or death in his hands, that a slip or a mistake may bring him within the reach of the criminal law, and that very often he has to decipher handwriting that would astonish the 'blind clerk' at the General Post-office; and it will be admitted that, on the whole, the invalid public is served well by the chemist and druggist."

ANSWERS TO CORRESPONDENTS.

W.—We do not remember one, but will make inquiries.

J. H.—We will keep the subject in mind.

J. C. F.—Decomposing lead soap (diachylon plaster) with carbonate of soda will give you a very pure oleate of soda.

N.—The French grain is less than the English. One gramme = 18·83 French grains.

J. B., Devon.—The application can do no harm. It is recommended in cases where the cause of baldness is supposed to be parasitic growth around the roots of the hair.

G. G. or 99.—We must thank our correspondent again for his communication. As he states, some are not errors, and most are unimportant. If the corrections were forwarded weekly, we could give a list of *errata*.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

New Method of Estimating Sulphides,
by M. VERSTRAET.*

THE estimation of alkaline sulphides is most important in very many industrial and commercial operations.

In the manufacture of carbonate of soda by Leblanc's process, an exact knowledge of the quantity of sulphides contained in the different operations is required every instant in the direction of the work; for the quality and whiteness of the salts almost always depend on the amount of sulphides contained in the rough soda, or which is formed during the lixiviation, under the influence of the temperature, and the contact of the soda with the solvent. An exact knowledge of the amount of sulphides is in this case absolutely necessary.

In the estimation of sulphides one of the indispensable conditions is that the process must be simple, easy, and rapid, and, above all, readily intelligible to the superintendents, all works not having experienced chemists at their disposal.

Several methods have already been proposed; M. Lestelle's is the most rapid, which estimates the sulphides by ammoniacal nitrate of silver in the presence of enough NH_3 to retain in solution all the salts of silver except the sulphides. This process, however, although quick and easy, has its inconveniences.

We have endeavoured to avoid these inconveniences by a process which we believe may be employed by any foreman or intelligent workman, and we hope that our expectations have been realised.

In the preparation of the standard solution, we substitute copper for silver. The quantity of copper required in the estimation of the sulphide will evidently vary according to the nature of the sulphide to be operated on. But suppose the question turns upon the estimation of sulphide of sodium.

As M. Pelouze has shown in an account of his simple and accurate method of estimating copper by a solution of sulphide of sodium, the sulphide of copper produced by the double decomposition which takes place when a solution of sulphide of sodium reacts upon another solution of ammoniacal nitrate of copper, at a temperature varying from 50° to 90°, is not the sulphide CuS, corresponding to the monosulphide of sodium NaS, but an oxysulphide $CuO,5CuS$. To obtain an exact estimation, it is, then, necessary always to operate at a temperature varying from 50° to 85°; this result may be easily obtained, even during the boiling of the liquids, by occasionally replacing the ammonia which is driven off. If the liquid is always ammoniacal, the temperature will not rise beyond 75°, as may be easily verified by plunging the thermometer once or twice into the liquid.

Before preparing the standard solution, care must be taken to ascertain that the materials to be used in its composition be free from impurity. The standard solution is prepared by dissolving 9·737 gr. of copper in about 40 grammes of nitric acid. The solution freed by the boiling from the hyponitric acid is mixed with from 180 to 200 grammes of ammonia, and water is then added so as to obtain a litre of liquid.

The copper should be exempt from other metals; it should dissolve completely in nitric acid, give no precipitate with ammonia, and, as M. Pelouze has shown, the precipitated oxysulphide $CuO,5CuS$, formed by making a solution of nitrate of copper react while hot upon a solution of sulphide of sodium, ought to have no action upon a small quantity of ammoniacal nitrate of copper; decolouration would show the presence of other metals in the copper.

Assay of Matter containing Sulphide of Sodium.—The quantity of material convenient for the experiment must necessarily vary according to the amount of sulphide which it contains, and to obtain a strict estimation, the quantity should, if possible, be such that a given amount of solution contains not more than from 0·10 gr. to 0·20 gr. of sulphide.

Suppose we take the determination of sulphide in rough soda. We take for the experiment 10 grammes of soda, which must be roughly pulverised and treated by 250 cubic centimetres of water; leave it to digest about an hour, agitating it at times, to accelerate the solution of soluble matters. It must be filtered to separate the insoluble residuum, and 50 cubic centimetres of the filtered liquid, representing 2 grammes of the rough soda, must be taken for the experiment.

Introduce these 50 cubic centimetres of solution into a small flask about 150 cubic centimetres in capacity, and add from 25 to 30 grammes of pure ammonia. Then heat the flask over a spirit lamp until it boils, which, on account of the ammonia, will be between 50° and 60°. Then add to the boiling solution, by the aid of a burette graduated and divided into tenths of a cubic centimetre, the standard solution of ammoniacal nitrate of copper. Agitate and boil from time to time, in order to facilitate the collecting of the deposit of the oxysulphide of copper. Towards the close of the operation add the standard solution, drop by drop, heating after each addition. Light shadows may then be perceived, at first black, afterwards yellowish, which rise from the bottom of the flask, and spread over the whole liquid. As we near the end of the experiments, these shadows become lighter and less coloured, on account of the smaller quantity of sulphide of copper which they contain. As soon as these little shadows have completely disappeared, the solution, under the influence of a drop of standard solution of copper, takes a light blue tint. This is a sign of the completion of the experiment. The next thing is merely to read off the burette the number of divisions of standard solution employed, to know exactly the quantity of sulphide contained in the rough soda. Suppose it near 6·5 cc.; as each cubic centimetre represents 0·01 gr. of pure, dry monosulphide the 6·5 cc., or the 50 cubic centimetres of solution of soda, representing 2 grammes of matter, contain 0·065 gr. of sulphide, equivalent to 3·25 per cent. Good sodas never contain more than from 0·2 to 0·4 of sulphide.

The experiment, we may easily see, is just completed, for after the addition of the first portion of the standard solution, the liquid took a dirty green colour, and remained turbid, because of the suspension of precipitated oxysulphide of copper clears immediately; the sulphide is more easily deposited, and collects at the bottom of the flask in light black flakes.

With a little practice, exceedingly minute quantities of sulphide may be easily detected, even down to about 0·001 gr. An experiment requires about ten minutes.

Still more to accelerate and simplify the process, we have prepared a standard solution of sulphide of sodium, in such a way that a litre of this second solution exactly saturates a litre of standard solution of copper. In this manner if, in any assay of sulphide of sodium, one has gone beyond the stage of precipitation by adding too much copper solution, it is always easy to return to the

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* *Comptes Rendus.*

exact determination, and to correct the experiment, without re-commencing it.

Testing of Sulphide of Potassium.—Sulphide of potassium is estimated in the same way as sulphide of sodium. But instead of using in the preparation of the standard solution of copper 9·737 gr. of pure copper, only 6·880 gr. should be employed.

On a Process of Fractional Condensation, applicable to the Separation of Bodies having small Differences between their Boiling Points, by C. M. WARREN.

(*Continued from page* 100.)

Having described the apparatus, I now proceed to give such details of the method of conducting the separations as have been found, in my experience, most efficient and economical of time. In commencing with a crude mixture of unknown liquids, I deem it advisable to operate at once on a tolerably large quantity of material, especially if the constituents are supposed to be numerous, and to omit chemical treatment till after the separations have so far progressed as to indicate the number and species of bodies present, and, approximately, their several boiling-points.

Notwithstanding the precautions taken to avoid loss from evaporation and leakage, I have at times been surprised at the large waste of material which has been made apparent after a long series of operations. When it is considered, however, that the time required to make a complete separation of a very complex mixture of liquids must necessarily be very protracted, during which more or less of evaporation is constantly taking place, it will be a matter of no surprise that the loss is so considerable. The quantity of material required must depend also on the proportions in which the various constituents are contained in the crude mixture, and upon their degree of volatility; but as these cannot be known *à priori*, it may suffice to make a single preliminary distillation of a portion of the mixture from a tabulated retort, to ascertain the range of temperature within which it distils, noting at the same time the proportions which come over between certain temperatures—as, for example, below 50° C., between 50° and 100°, &c. From these data one may judge pretty nearly of the quantity which it will be advisable to take. It is evident that when very volatile bodies are present, even in considerable proportion, a much larger quantity would be required than if the material were but slightly volatile, as the waste in the former case from evaporation would be much greater.

But in many cases it will be found that highly volatile bodies are present only in very small proportion—*e.g.*, in viscid petroleums like Rangoon tar, and in the products of distillation of some species of asphalt. In such cases, the requisite quantity to be operated upon to obtain the most volatile constituents in sufficient quantity for anything like a complete study of their chemical relations would be extremely large—too large to be conducted in the laboratory—and one would have to resort to the manufactory for the first distillation. I have dwelt at some length on this point, having experienced the disappointment which one feels, after months of labour, on finding the products insufficient for his requirements, when the expenditure of a little more time, comparatively, might have given double the quantities obtained.

In the first series of fractioning I generally operate on successive portions of about one gallon each of the crude material, and take off a fraction for every 20° C. rise of temperature of the retort. These fractions are preserved in well-stoppered bottles, and each carefully labelled with the temperatures between which it was obtained. The fractions for each fresh portion of the crude material being collected between the same limits of temperature, are added to the corresponding products from the preceding operations till enough of the crude material has been taken to insure ultimately a sufficiency of the pure products.

In the commencement, not only of this but of all subsequent fractionings, when the temperature to which the bath should be raised is unknown, I first bring the liquid in the retort into full ebullition, so that a steady stream of liquid should flow back from the end of the worm into the retort. I then carefully raise the temperature of the bath until the vapours from the retort pass through the heated worm so freely that the liquid, in condensing from them, shall drop with tolerable rapidity into the cold receiver. In order that this dropping may be continuous, it is necessary that the temperature of the bath should rise very gradually as the more volatile constituents of the mixture are taken off. This is easily effected by carefully regulating the flame under the bath.

It is advisable to boil the retort as rapidly as possible without choking the lower end of the heated worm with the returning liquid. As this choking would give rise to additional pressure in the retort, and consequently occasion abnormal elevation of the temperature, and possibly a rush of liquid into the receiver, and thus introduce irregularities in the work, excessive heat under the retort should be avoided. The first indication of choking of the worm is a partial or entire stoppage of the stream of liquid which normally flows steadily from the end of the worm into the retort. Any interruption or unsteadiness of this flow would indicate too rapid ebullition.

As a rule, other things being equal, the greater the difference between the temperature of the bath and that of the retort, the slower the products will come off, and the more effectual will be the separation. I think it possible, however, that the earlier fractionings may be conducted so slowly that the loss of time would more than counterbalance what might be gained by more thorough separation, and that equally good results may be more economically obtained by more frequent operations, somewhat more rapidly conducted.

A striking illustration of the advantage to be gained by this process is presented by the fact that, during the first fractioning of a crude mixture, such as American petroleum or coal-tar naphtha, for example, the difference between the temperature of the bath and that of the retort may sometimes be as much as 35° C., or even more; while, as the products become purer, this difference between the temperatures of the bath and retort proportionally decreases, till finally, in operating on a pure product, the temperature of the bath must be brought to within a few degrees of that of the retort, in order to bring the vapours through. But the amount of this difference is variable for different bodies of equal purity.

These first fractionings must necessarily be quite arbitrary, for, as a general rule, when operating on such mixtures as those just mentioned, neither the thermometer nor the quantities obtained for any given range of temperature will indicate any decided preponderance of any one substance. On the contrary, the temperature rises uniformly, and about the same quantity is generally obtained for the same number of degrees of temperature throughout the operation. In other mixtures, in which certain bodies may seem to be present in much larger proportion than others, or in which there may be a greater difference between the boiling points of the constituents than in the cases referred to—facts which would be indicated by the thermometer of the retort and by the relative quantities of the products obtained—there might be something gained by exercising discretion in taking off fractions according to these indications.

In the second series of fractioning, the first or lowest fraction of the preceding series, which is large enough to operate upon by itself, is transferred to the retort, and brought into ebullition. The temperature of the bath is then adjusted as above described, and the distillation continued, the fractions obtained being placed in their appropriate bottles until the temperature of the retort shall have risen to, or somewhat above, the point at which the second or next succeeding fraction of the first series may be supposed, or has been found by experiment, to boil. This fraction is then added to the residue in the retort, and the distillation is continued as before. In the same manner, I proceed with the remaining fractions of the first series.

All subsequent fractionings are similarly conducted. As the work progresses, however, the fractions are taken for a gradually decreasing number of degrees of temperature, until finally it becomes necessary, for the attainment of absolute constancy of boiling point, to take off a fraction for every degree, Centigrade; and to continue thus to operate on these fractions, each representing one degree of temperature, until the desired end is attained.

The operator will observe that, in each series of fractions, in which each fraction has been taken for the same range of temperature, the difference between the boiling points of any two contiguous fractions is nearly the same as the difference between any other two contiguous fractions—in other words, that the difference referred to approximates to a common difference throughout the same series. Once ascertained, this difference serves as a valuable guide in determining with sufficient accuracy when to add the next fraction to the retort. By observing this systematic course, irregularities from the improper mixture of products may be avoided, and time thus economised.

After a few series of fractionings—sometimes after two or three, variable in number, according to the nature or complication of the mixture—it will be found that some of the fractions are considerably larger than others for the same range of temperature, indicating approximately the boiling points of the several constituents. But fractions of constant boiling point, or those the boiling points of which cannot be sensibly changed by further fractional condensation, are not obtained, as already mentioned, till after repeated careful fractioning for every degree of temperature. When fractioning for every degree, it is important to use every precaution to protect the thermometer from external influences, and to carefully apply the corrections for variations in the atmospheric pressure. This may even be desirable earlier; but it is of so much importance in the case specified, that, if omitted, the operator would be liable one day to mix products which he had separated the day previous.

In this way certain larger fractions are obtained, which are not susceptible of further alteration in their boiling points; but there are yet considerable quantities of liquid in the intermediate fractions, which still continue to change more or less in each succeeding operation. When the fractions of constant boiling point have once been obtained, if it were not important to test for other bodies in the intermediate fractions, the operation might here be suspended, provided the pure products already obtained should be large enough for the purposes required.

But, in my investigations, I have undertaken to prove the negative as well as the positive. I have attempted to carry the process of separation so far that I might assert the absence of other bodies as well as the presence of those obtained; and this clearing up of the intermediate fractions has generally been the most tedious part of the work. I have continued to operate upon these by themselves, until they also have become distributed in regular course—no new bodies appearing—among the fractions of constant boiling point, or to such an extent that the intermediate quantities have become too small to admit of further continuance of the process.

This process has been in constant use in my laboratory during the last three years. In this time it has been applied in the study of petroleums, coal oils, the more volatile parts of coal and wood tars, the essential oil of cumin, commercial fusel oil, from corn whiskey, and even to mixtures more complex than either of these. As the result of this long experience, I can say that, as regards bodies not decomposed by heat in distillation, I have not yet found a mixture so complex that it may not be resolved by this process into its proximate constituents so completely that these shall have almost absolutely constant boiling points. In repeated instances, even from petroleums, I have obtained these constituents so pure that the contents of an ordinary tubulated retort charged with one of them has been completely distilled off without any essential change of temperature—*i.e.*, not to the amount of ⅛° C., the thermometer frequently remaining absolutely constant for more than half an hour—a constancy of boiling point not exceeded by that of distilled water. This state of purity, I think I may safely assert, has never before been attained from such mixtures by any system of fractional distillation.

As I shall soon be prepared to present to the Academy detailed results of the investigations above referred to, I may omit further allusion to them on this occasion.

I would remark, in conclusion, that it seems to me not improbable that this process may ultimately prove to be of great value in the arts. It is not too much to anticipate that, whenever the various constituents of the mixtures referred to shall have been separately and thoroughly studied in a pure state, some of them may be found to possess properties which will give to them great commercial value, sufficient to justify the expenditure necessary to separate them in large quantities.

PHARMACY, TOXICOLOGY, &c.

Cause of the Solidification of Balsam of Copaiba by Lime and Magnesia, by M. Roussin.*

The cause of the solidification of balsam of copaiba has been until now either unknown or unappreciated. We know, for example, that genuine balsams of the best quality often resist solidification, whilst products of a very doubtful quality rapidly solidify. The following experiments, selected from a larger series, seem to throw some light upon the question.

If balsam of copaiba of the very finest quality is mixed with a twelfth part of its weight of quicklime reduced to a very fine powder (it is necessary to employ rich lime) no sign of solidification takes place, and the substances might remain in contact for any length of time without undergoing any combination. If, into such a

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* *Journal de Pharmacie et de Chimie*, April, 1865.

liquid combination, enough water to hydrate the quicklime is incorporated by agitation, the temperature becomes considerably raised, and in a few hours the entire mass solidifies into a very homogenous pill-like consistence. The proportion of water required is almost exactly a third of the lime employed.

On repeating the previous experiment with ordinary calcined magnesia, M. Roussin established—1. That divers commercial balsams of copaiba contain a considerable proportion of water, which they will lose if exposed for a long time under a glass receiver, enclosing fragments of chloride of calcium or of carbonate of potash; 2. That the commercial calcined magnesia readily attracts the moisture of the air, and, after having been some time in a badly stopped vessel, always contains considerable quantities of water, sometimes to the extent of 15 and 20 per cent.

If a specimen of good balsam of copaiba is divided into two equal parts, and having properly dried the first portion under a receiver, and sufficiently hydrated the other by placing it in a damp vessel, each portion is then mixed with one-sixteenth its weight of recently calcined magnesia, the dried portion remains liquid, and the magnesia in great part even sinks to the bottom of the vessel, while the second portion, on the contrary, becomes a hard mass of pillular consistence.

The above facts show the necessity of the agency of water in order to bring about the combination of the resin of the balsam of copaiba with the lime and the magnesia. M. Roussin purposes to develope these results in a more extended investigation.

PROCEEDINGS OF SOCIETIES.

COLLEGE OF PHYSICIANS.

"*On Animal Chemistry.*" A course of Six Lectures by William Odling, M.B., F.R.S., F.R.C.P.

Wednesday, May 10, 1865.

Lecture 5.

Muscular action dependent on muscular metamorphosis—Theoretic oxidation of muscle into one proportion of urea and seven of carbonic acid—Practical results—Dynamic value of muscle oxidation—Quantities of heat producible by combustion of hydrogen and carbon—Difference between quantity and intensity of heat—Unit of heat equivalent to 430 kilogram-metres of motion—Quantities of motion producible by combustion of hydrogen and carbon—Economy of muscle as a motive exponent of combustion—Reciprocity of heat and motion in muscular action—Muscular force traceable to the sun—Amount of force derivable from muscle proportional to degree of its oxidation—Imperfect knowledge of natural process of oxidation—Artificial oxidation of muscle—Nature of intermediate products—Relations of aldehydes and nitriles to acids—Simple constitution of acids obtained by muscle oxidation—Production of both fatty and aromatic compounds—Natural occurrence of leucine and tyrosine—Their formation by indirect oxidation of nitrogeneous tissue—Leucine the most elaborate of fatty, and tyrosine of aromatic animal products—Constitution and analogies of leucine—Probable constitution of tyrosine—Its relation to hippuric acid.

That muscular exertion is dependent on muscular metamorphosis or oxidation is a subject rather for the physiologist than the chemist to dilate upon. Perhaps, however, I may be permitted to remind you of such observations as the following—that a free supply of thoroughly oxygenated arterial blood is essential for complete well-developed muscular action; that the volume of oxygen contained in blood which has circulated through a muscle in action is less than one-fourth of that contained in blood which has traversed a muscle at rest, while there is a corresponding increase, not of course an equal increase, in the volume of its carbonic acid; that the irritability of muscular fibre out of the body is arrested by its removal from oxygen, and again manifested on its re-exposure thereto; and lastly, that other things being equal, the amount of urea excreted by the kidneys, and of carbonic acid excreted by the lungs, is proportionate to the muscular activity of the individual. Seeing, then, that muscular exertion is really dependent upon muscular oxidation, we have to consider what should be the products, and what the value of its oxidation.

Unfortunately, the precise molecular formula—the exact chemical constitution—of muscle is at present unknown. But in muscle, as in all the albuminoid class of bodies, we do know the ratio in which the constituent carbon and nitrogen stand to one another. Thus it is established beyond all question that the ratio of the number of atoms of carbon to the number of the atoms of nitrogen in muscle is as nearly as possible, if not quite exactly, four to one. In the most minute fragment of muscle, then, for every single atomic proportion of nitrogen there are four atomic proportions of carbon, thus:—

4 Carbon to 1 Nitrogen.

It will be more convenient, however, to express this ratio by the doubles of the above numbers, so that, instead of four to one, we will adopt eight to two, as our expression of the atomic ratio of carbon to hydrogen in every particle of muscle:—

8 Carbon to 2 Nitrogen.

Admitting, as a result of its ultimate metamorphosis, that the whole of the nitrogen of muscle is converted into urea, let us first consider what proportion of its carbon of muscle must be associated with this nitrogen, and what proportion be left for excretion in the form of carbonic acid. Now, although the molecular constitution of muscle is undetermined, that of urea is perfectly definite.* As shown by its formula, CH_4N_2O, the molecule of urea consists of one atom of carbon, four atoms of hydrogen, two atoms of nitrogen, and one atom of oxygen. In other words, leaving out of consideration its hydrogen and oxygen, the atomic ratio of carbon to nitrogen in urea is as one to two. Accordingly, every two atoms of nitrogen in urea have one atom of carbon associated with them; so that if we take the two proportions of nitrogen existing in muscle and add thereto the one proportion of carbon necessary to form urea, we shall have seven proportions of carbon left for conversion into carbonic acid, thus:—

$$7\text{-Carbon} \quad \text{to} \quad \left\{\begin{array}{l}1\text{-Carbon}\\ 2\text{-Nitrogen.}\end{array}\right.$$

The theoretical result, then, of the complete oxidation of muscle is the appearance of one-eighth of its carbon in the form of urea, and of seven-eighths of its carbon in the form of carbonic acid.

Now, let us see what is the actual result. We have two series of experiments made by Bischof and Voit, and Pettenkofer and Voit respectively, in which lean dogs were fed exclusively upon a moderate diet of flesh. In the first series of experiments a small proportion of fat left in the flesh was duly allowed for; while in the second series of experiments the fat was entirely removed. The general results of these two series of experiments are shown below:—

C. of carb. acid.		C. of urea.	
7·29	to	1	Bischof and Voit.
6·85	to	1	Pettenkofer and Voit.
7·07	to	1	Mean.

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* This mode of viewing the relationship of muscle to urea and carbonic acid was suggested by Dr. Lyon Playfair's essay "On the Food of Man in Relation to his Useful Work," to which I am otherwise much indebted in the early part of this lecture.

Thus the ratio of carbon excreted in the form of carbonic acid to carbon excreted in the form of urea was as 7·29 to 1 in the first series of experiments, as 6·85 to 1 in the second series, and as 7·07 to 1 in the mean of the two. Theoretically, then, the ratio of carbon in carbonic acid to carbon in urea is as 7 to 1; experimentally it is found to be as 7·07 to 1—a striking mutual corroboration of the two methods of calculation and research.

With regard to the dynamic value of muscle oxidation, I told you in my last lecture that by the separation of oxygen from carbo-hydrogen a certain amount of heat force was absorbed and rendered latent in the separated bodies, which, by the re-combination of these bodies, was again liberated and rendered sensible. Now, we find that in all re-combinations of separated constituents, the quantity of heat evolved is perfectly definite and invariable. Confining our attention to hydrogen, and speaking in round numbers, we may say that the heat evolved by burning a cubic foot of hydrogen—that is, by combining a cubic foot of hydrogen with half a cubic foot of oxygen—will raise the temperature of $5\frac{1}{4}$ cubic feet of water one degree Fahrenheit; or that the heat of burning hydrogen is capable of raising the temperature of $5\frac{1}{4}$ times its bulk of water one degree. But we know that the quantity of matter in a body is proportionate to its weight, and accordingly we get a much better idea of the amount of heat developed, by comparing the items gravimetrically rather than volumetrically. Thus we find that the combustion of one part by weight of hydrogen will evolve an amount of heat sufficient to raise the temperature of more than 60,000 parts of water one degree Fahrenheit, or 34,000 parts of water one degree centigrade. Now, in comparing the amounts of heat given out by the combustion of different substances, it is convenient to have some definite standard of comparison; and the usual continental standard is altogether, perhaps, the most convenient. According to this standard, the amount of heat given out by one kilogramme of water in cooling one degree centigrade, or, of course, the amount of heat absorbed by one kilogramme of water in rising one degree centigrade is called the unit of heat. We find, then, that when one gramme of hydrogen gas is burned into water it gives out 34 units of heat; or it will raise the temperature of 34 kilogrammes—that is, 34,000 times its own weight—of water one degree centigrade.

Turning our attention to carbon, we find that one gramme of carbon, in being oxidised or burned into carbonic anhydride, gives out 8 units of heat, or will raise the temperature of 8 kilogrammes — that is to say, 8000 times its own weight—of water one degree. Now, the quantity of heat evolved during the oxidation of a given weight of hydrogen, carbon, or any other combustible, is perfectly independent of the rapidity or slowness of the action. Provided only that the same products are formed, the same amount of heat is liberated in their production, whether it takes place rapidly or slowly, violently or gradually. It is only the intensity of the heat, and not its quantity, which varies with the rapidity of the combination. When a stout piece of iron rusts in the air we get oxide of iron produced as the result of the slow burning of the metal, but there is no obvious rise of temperature! On the other hand, when a piece of iron wire is burned in oxygen gas, we have a brilliant combustion, with an intense development of heat. In reality, the products formed in these two cases are not identical, but only allied. Assuming them, however, to be identical, the amount of heat given out in the rapid burning of the metal would be identical with that given out during its slow rusting. The difference is merely that in the one case all the heat is given out in the course of a few seconds, that there is a great quantity of heat produced in a short time; while in the other case this same quantity of heat is developed only during a long series of years. As a matter of fact, the quantity of heat evolved by the slow rusting of a given weight of iron is considerably greater than that evolved by its rapid combustion in oxygen, the resulting compound being not only more highly oxidised, but in a state of hydration, or combination with solid water.

I may illustrate this to you by a very ordinary experiment. When a plate of copper is immersed in a jar of chlorine gas, for instance, the chlorine gradually combines with the metal, and there is no evident rise of temperature; but when very thin copper leaf is immersed in chlorine gas, the combination takes place instantaneously, with evolution of sufficient heat to render the leaf luminous—with vivid combustion, in fact—as you perceive. Now, the amount of heat given out under these opposite circumstances is identical; the only difference is in its intensity—in the quantity of heat associated with a given quantity of matter at a given moment. In the last case, the action being instantaneous, and the quantity of matter to be heated very small, we have what we call an intense heat—that is, the momentary association of a large quantity of heat with a small quantity of matter; whereas in the other case, the action being gradual, the development of heat is likewise gradual, spread over a long period of time, and associated with a large quantity of matter; the increased temperature of which is, therefore, at no one moment very perceptible. The terms quantity and intensity of heat are strictly analogous to the terms quantity and velocity of motion. In a pound weight of iron raised to 1000°—the melting point of silver,—or ten pounds weight raised to 100°—the boiling point of water,—the quantity of heat capable of being imparted—say, to a gallon of cold water—is substantially the same, though the intensity of the heat is ten times as great in the one case as the other; just as the quantity of motion is the same in a pound weight moving at the rate of 1000 feet, or a ten pound weight moving at the rate of 100 feet per second, although the velocity of motion is ten times as great in the one case as the other. We come, then, to this conclusion—that chemical action, whether rapid or slow, provided only that the same substances react and the same products result, always furnishes the same amount of heat.

Now, let us apply this to hydrogen, one of the fuel constituents burnt in our tissues. If we inflame a mixture of oxygen and hydrogen gases, the combination and evolution of heat being alike instantaneous, we obtain the most intense degree of heat capable of being produced by direct chemical action. On the other hand, if we take the same mixture of oxygen and hydrogen gases, and cause them to unite slowly by means of spongy platinum, the oxidation is spread over a considerable period of time, and, the heat being developed during a period of many minutes, there is no great manifestation of temperature at any one instant. The quantity of heat is, however, the same in both cases. One gramme of hydrogen in combining with oxygen, whether quickly or slowly, will always evolve 34 units of heat; and one gramme of carbon in combining with oxygen, whether quickly or slowly, will always evolve 8 units of heat. The slow oxidation of so much carbon and hydrogen in the human body will always produce its due amount of heat, or an equivalent in some other form of energy; for while the latent force liberated in the combustion of the carbon and hydrogen of fat is expressed solely in the form of heat, the combustion of an equal quantity of the carbon and hydrogen of voluntary muscle is expressed chiefly in the form of motion. You may remember that I referred in my last lecture to the equivalency subsisting between heat and motion—to the circumstance that so much heat was convertible into so much motion. Accordingly, when we burn hydrogen or carbon, instead of getting the heat force which was exerted in separating them from oxygen remanifested in the form of heat, under certain circumstances we get it manifested in the form of motion.

Let us next consider what are the quantitative relations subsisting between heat and motion. We have taken as our unit of heat the quantity of heat absorbed or evolved by one gramme of water in rising or falling through one centigrade degree of temperature. Now, this is found by experiment to be the exact quantity of heat generated by collision with the earth of a kilogramme weight falling from a height of 430 metres. The mechanical force, then, of a kilogramme weight which has fallen through 430 metres, or, in other words, the mechanical force necessary to lift a kilogramme weight to the height of 430 metres, is equal to, interchangeable for, and convertible into the heat force evolved or absorbed by a kilogramme of water in changing its temperature one degree. Or the arrest of one unit of motion would raise the temperature of a kilogramme of water at zero 1 degree, and conversely, the absorption of one unit of heat would lift a kilogramme weight to the height of 430 metres. Of course, the force necessary to lift 1 kilo. through 430 metres, or 10 kilos. through 43 metres, or 430 kilos. through 1 metre, is the same; whence it is convenient to apply the expression kilogram-metre to the product of the kilos. lifted into the metres of height, and to say that the heat evolved by the cooling of a kilogramme of water one degree is equal to 430 kilogram-metres of motion, and *vice versâ*. Or we may adopt Mr. Joule's original standard, and say that the heat evolved by the cooling of a pound of water one degree Fahrenheit is equal to 772 foot-pounds of motion.

The applicability of these considerations to the combustions of hydrogen and carbon taking place in the animal body is obvious. We have said that the combustion of 1 gramme of hydrogen evolves 34 units of heat, and that a unit of heat is equal to 430 kilogram-metres of motion; so that the combustion of 1 gramme of hydrogen will produce 34 × 430 = 14,600 kilogram-metres of motion; or will serve to lift 1 kilogramme weight through 14,600 metres of height, or 14,600 kilogrammes through 1 metre of height, &c., &c. Similarly, the combustion of 1 gramme of carbon will suffice to produce 3440 kilogram-metres of motion, thus:—

	One gramme burnt.				Kilogram-metres of motion.
HYDROGEN	34	×	430	=	14,600
CARBON	8	×	430	=	3,440

In this way, then, we can form some idea of the mechanical power generated, or quantity of motion producible, by the combustion of the hydrogen and carbon of our muscles into water, and carbonic acid or urea respectively.[†] Our knowledge of the intimate constitution of muscle is, however, too imperfect to allow of our estimating the amount of motion producible by its oxidation with any degree of exactitude; but, as the result of a rough calculation, it may be taken that the combustion of the unburnt carbo-hydrogen of one gramme of dry muscle, free from fat, is capable of furnishing 1950 kilogram-metres of motion, or will suffice to lift 1950 kilogrammes to the height of 1 metre.[‡]

Now, although the ratio of the amount of motion actually produced to that theoretically producible by the combustion of a given weight of muscle, has not, I believe, been satisfactorily ascertained, this much is certain,—that muscular tissue is, without exception, by far the most perfect of machines for manifesting the force liberated by chemical action in the form of motion. No artificial contrivance with which we are acquainted is at all comparable to it in economy—that is to say, in the proportion of mechanical work performed to the total force liberated. The steam-engine, for instance, is an artificial machine, expressly intended for the conversion of chemical force into motion. Heat is generated in the boiler-furnace by a combination of the carbo-hydrogen of the coal with the oxygen of the air, but only a certain amount of this heat is absorbed in the evaporated water, and then only a certain amount of the heat so absorbed is translated into motion. Now it appears that by burning, or consuming, or oxidating a given weight of muscle in our bodies, we obtain a quantity of available motive force which would require for its production the combustion of at least five or six times its weight of coal in the most perfect steam-engine that ever was constructed.

The superior economy of muscle over any artificial contrivance, as a motive machine, seems to depend in great measure upon the circumstance of the force liberated by its oxidation being expressed directly in motion, instead of first appearing in some intermediate form of energy. Thus, in a steam-engine, the immediate effect of the oxidation is not motion, but heat, some of which eventually or intermediately appears as external motion. In this case, the combination produces heat, and the heat is afterwards transformed into motion; whereas, in muscular tissue, the the combination first produces motion, which is afterwards, in many cases, transformed into heat. The force liberated by the combustion of the muscular fibre of the heart, for instance, is expressed directly in the contraction of its ventricles, and the consequent propulsion of the blood through the greater and less circulations. But by the time the blood gets back to the heart, it has given up all its motion, and requires to be again propelled by another contraction of the ventricles, and so on. Now, what becomes of the motion received by the blood at each contraction? It appears in the form of heat. The blood circulating through the vessels and capillaries undergoes a certain amount of friction. It is brought to a state of rest gradually by the hindrance to its motion, just as a bullet is brought to rest suddenly by the hindrance to its motion; and, in both cases, that which was motion becomes heat. The quantity of heat finally produced by the friction of the blood is generated as truly by the combustion of the heart-fibre, as if we had burnt it directly in a furnace, without any intermediate manifestation of motion. In some cases, indeed, the oxidation of muscle within our bodies produces a direct liberation of heat instead of motion. Thus, in the case of a person lifting a weight, the combustion of his tissue is expressed in the motion of the weight; but suppose he only attempts to lift a weight which is too heavy for him, there is then no production of motion, but instead of it a corresponding increase of temperature in the muscle. In tetanus, again, where the violent contraction of the muscles produces no external motion, their temperature has been observed to increase as much as six degrees centigrade or eleven degrees Fahrenheit above the normal state. Conversely, in the case of a man working a treadmill, although the amount of heat evolved from his person is absolutely larger, its proportion, relatively to the amount of tissue burned, is smaller than in the case of a person at rest, by a difference equivalent to the external work performed. But in fever, where there is a rapid destruction of tissue without any corresponding mechanical effect, we have a high degree of external heat.

Thus we return once again to the conclusion which

[†] The heat produced by the conversion of carbon into urea is doubtless that producible by its conversion into carbonic anhydride CO_2, and not merely that producible by its conversion into carbonic oxide CO, as sometimes represented.

[‡] Assuming for muscle the formula $C_{12}H_{19}N_3O_4 \times 6$, and subtracting all the oxygen and nitrogen, with the necessary hydrogen, in the forms of water and ammonia, so as to leave a residue of $C_{12}H_2 \times 6$, 269 grammes of muscle would leave 144 grammes of carbon and 2 grammes of hydrogen for oxidation, which should furnish 524,560 kilo-gram-metres of motion, thus:—

	Grammes.		Kilogram-metres.		
CARBON . . .	144	×	3,440	=	495,360
HYDROGEN . .	2	×	14,600	=	29,200
					524,560

Hence one gramme of muscle should furnish 524,560 ÷ 269 = 1590 kilogram-metres of motion. Accepting this result, it would follow from the experimental determinations of Valentin and Pousseuille, and the calculations of Mayer, who, together with Mr. Joule, is the great apostle of energetics, that the entire substance of the ventricles would be consumed in maintaining little more than two days' work of the heart. Of course some of the data on which this calculation is based are but very roughly approximative.

I brought more prominently under your notice in my last lecture. We perceive that muscular exertion does not result from vital force generated within the body, or, indeed, from force of any kind generated within the body, but only from a liberation within the body of pent-up solar force, which at some time or other had been rendered latent in the separated carbo-hydrate of our food on the one hand, and oxygen of our breath on the other. As well observed by Dr. Tyndall,—"It is at his (*i.e.*, the sun's) cost that animal heat is produced, and animal motion accomplished. Not only is the sun chilled, that we may have our fires, but he is likewise chilled that we may have our powers of locomotion." From the terms in which, upon that occasion, I referred to the fiction of vital force, some physiologists who honoured me by their presence seemed to infer that chemists and physicists were insensible to those important distinctions existing between living and dead matter, which they profess to explain by declaring the former to be possessed, and the latter dispossessed, of vital force. I believe, however, that chemists appreciate in its fullest extent what may be termed the mystery of life, but they look upon the physiologists' explanation as a mere periphrasis,—as only another mode of saying that dead matter differs from living matter because it is dead, while living matter differs from dead matter because it is alive. Chemists and physicists are well assured that, be life what it may, it is not a generator, but only a transformer, of external force. In the vegetable kingdom solar force is absorbed, in the animal kingdom it is liberated by the eremacausis of our fat and muscle.

Now, the full realisation of the force derivable from a given weight of muscle depends upon its complete oxidation into water and carbonic acid or urea. Should it be only converted into sugar, or kreatine, or uric acid, these are imperfectly burned substances, which still retain a certain amount of potential energy liberable from them by further oxidation. They still contain associated with them some portion of the latent force put into the original tissue-constituents at the period of their formation, and accordingly, by their further oxidation, we are capable of getting an additional amount of work out of them. In order, therefore, to obtain the full equivalent of heat force or motive force to which we are entitled by the waste of our tissues, it is important that this waste should be thorough, that both the hydrogen and carbon should be converted into the most completely oxidised compounds they are susceptible of forming,—the whole of the hydrogen into water, and the whole of the carbon into its most stable mono-carbon compound, namely, carbonic acid, or the ammoniated form of this acid, namely, urea. In some cases of imperfect oxidation, however, we get less oxidised, and more complex, dicarbon molecules produced, such, for example, as oxalic acid, which occurs either in its normal saline state, or colligated with urea in the form of allantoine, oxaluric acid, &c. In cases of yet more imperfect oxidation, we meet with still less oxidised tricarbon molecules, such, for example, as the mesoxalic compound, which forms uric acid by its colligation with urea. We may even have tetracarbon molecules such as succinic acid, pentacarbon molecules such as amido-valeric acid or phocine, hexacarbon compounds such as amido-caproic acid or leucine, and heptacarbon compounds such as the benzoic residue of hippuric acid, and the salicic residue of tyrosine.

In certain processes of artificial oxidation to which I referred in a former lecture, we obtain, as you may remember, from any particular substance a series of less and less complex bodies terminating in carbonic acid; or, to use again the words of Gerhardt, we gradually descend the scale of complexity, converting the original substance into more and more simple products by successively burning off a portion of its carbon and hydrogen. In other cases, however, as in Gorup-Besanez's experiments upon the oxidation effected by ozone in alkaline liquids, whether or not a series of bodies intermediate between the initial substance and final carbonic acid are really formed, we are quite incapable of detecting them, and, consequently, of tracing their metamorphoses. The constituent carbon atoms of the original substance seem, at any rate, to become at once completely isolated, and oxidised. Whether, therefore, the more complex molecules formed by natural tissue-oxidation are to be regarded as direct, but intermediate, products of the principal oxidation, or as bye products resulting from subsidiary processes, is at present an open question, though the balance of evidence with regard to certain products, at any rate, seems to be in favour of the latter view. In any case, however, the formation and even excretion of some or other of these bodies, in greater or less proportion, according to the nature of the organism,—uric acid largely in birds and land reptiles, hippuric acid largely in herbivora, and both acids sparingly in mankind—are obviously normal or healthy actions. By the excretion of such imperfectly burned substances, indeed, a certain amount of force does not become utilised within the animal, but this prodigality of force in organic nature is far inferior to that which we observe in the inorganic world.

(To be continued.)

BRITISH ASSOCIATION.

Birmingham Meeting, President, Professor Phillips, *M.A., &c., &c.*

President's Address, delivered September 6.

Assembled for the third time in this busy centre of industrious England, amid the roar of engines and the clang of hammers, where the strongest powers of nature are trained to work in the fairy chains of art, how softly falls upon the ear the accent of Science, the friend of that art, and the guide of that industry! Here, where Priestley analysed the air, and Watt obtained the mastery over steam, it well becomes the students of nature to gather round the standard which they carried so far into the fields of knowledge. And when, on other occasions, we meet in quiet colleges and academic halls, how gladly welcome is the union of fresh discoveries and new inventions with the solid and venerable truths which are there treasured and taught. Long may such union last; the fair alliance of cultivated thought and practical skill; for by it labour is dignified and science fertilised, and the condition of human society exalted!

Through this happy union of science and art, the young life of the British Association,—one-third of a century,—has been illustrated by discoveries and enriched by useful inventions in a degree never surpassed. How else could we have gained that knowledge of the laws of nature which has added to the working strength of a thousand millions of men the mightier power of steam*, extracted from the buried ruins of primeval forests their treasured elements of heat and light and colour, and brought under the control of the human finger, and converted into a messenger of man's gentlest thoughts, the dangerous mystery of the lightning?†

How many questions have we asked—not always in vain—regarding the constitution of the earth, its history as a planet, its place in creation;—now probing with sharpened

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* The quantity of coal dug in Great Britain in the year 1864 appears by the returns of Mr. R. Hunt to have been 92,787,873 tons. This would yield, if employed in steam engines of good construction, an amount of available force about equal to that of the whole human race. But in the combustion of coal not less than ten times this amount of force is actually set free—nine-tenths being at present unavailable, according to the statement of Sir William Armstrong, in his address to the meeting at Newcastle in 1863.

† The definite magnetic effect of an electrical current was the discovery of Oersted in 1819; Cooke and Wheatstone's patent for an electric telegraph is dated in 1837; the first message across the Atlantic was delivered in 1858. Tantæ molis erat.

eyes the peopled space around—peopled with a thousand times ten thousand stars;—now floating above the clouds in colder and clearer air;—now traversing the polar ice—the desert sand—the virgin forest—the unconquered mountain;—now sounding the depths of the ocean, or diving into the dark places of the earth. Everywhere curiosity, everywhere discovery, everywhere enjoyment, everywhere some useful and therefore some worthy result. Life in every form, of every grade, in every stage; man in every clime and under all conditions; the life that now surrounds us, and that which has passed away;—these subjects of high contemplation have been examined often, if not always, in the spirit of that philosophy which is slowly raising, on a broad security of observed facts, sure inductions, and repeated experiments, the steady columns of the temple of physical truth.

Few of the great branches of the study of nature on which modern philosophy is intent were left unconsidered in the schools of Athens; hardly one of them was, or, indeed, could be, made the subject of accurate experiment. The precious instruments of exact research—the measures of time, and space, and force, and motion—are of very modern date. If, instead of the few lenses and mirrors of which traces appear in Greek and Roman writers,[‡] there had been even the first Galilean or the smallest Newtonian telescope in the hands of Hipparchus, Eratosthenes, or Ptolemy, would it have been left to their remote successors to be still struggling with the elements of physical astronomy, and waiting with impatience till another quarter of a century shall have rolled away, and given us one more good chance of measuring the distance of the sun by the transit of Venus? Had such instruments as Wheatstone's chronoscope been invented, would it have been left to Foucault to condense into his own apartment an experimental proof of the velocity of light, and within a tract of thirty feet to determine the rate of its movement through all the vast planetary space of millions and thousands of millions of miles, more exactly than had been inferred by astronomers from observations of the satellites of Jupiter?[§] By this experiment the velocity of light appears to be less, sensibly less, than was previously admitted; and this conclusion is of the highest interest; for, as by assuming too long a radius for the orbit of Jupiter, the calculated rate of light-movement was too great, so now, by employing the more exact rate and the same measures of time, we can correct the estimated distance of Jupiter and all the other planets from the sun. We have, in fact, a really independent measure of planetary space; and it concurs with observations of the parallax of Mars, in requiring a considerable reduction of the assumed diameters of the planetary paths. The distance of the earth from the sun must be reduced from above ninety-five to less than ninety-three millions of miles, and by this scale the other space-measures of the solar system, excepting the diameter of the earth and the distance and diameter of the moon, may be corrected.[‖]

The light and heat which are emitted from the sun reach the earth without great diminution by the absorptive action of the atmosphere; but the waste of heat from the surface of our planet through radiation into space is prevented, or rather lessened by this same atmosphere. Many transparent bodies admit freely heat rays derived from a source of high temperature, but stop the rays which emanate from bodies only slightly warmed. The atmosphere possesses this quality in a remarkable degree, and owes it to the presence of diffused water and vapour; a fact which Dr. Tyndall has placed in the clear light of complete and varied experiment.[¶] The application of this truth to the history of the earth and of the other planets is obvious. The vaporous atmosphere acts like warm clothing to the earth. By an augmented quantity of vapour dissolved, and water suspended in the air, the waste of surface-heat of the earth would be more impeded; the soil, the water, and the lower parts of the atmosphere would grow warmer; the climates would be more equalised; the general conditions more like what has been supposed to be the state of land, sea, and air, during the geological period of the coal-measures.

Such an augmentation of the watery constituents in the atmosphere would be a natural consequence of that greater flow of heat from the interior, which by many geologists, mathematicians, and chemists is supposed to have happened in the earlier periods of the history of the earth.

By the same considerations we may understand how the planet Mars, which receives not half so much heat from the sun[**] as the earth does, may yet enjoy, as in fact it seems to enjoy, nearly a similar climate, with snows alternately gathering on one or the other of its poles, and spreading over large spaces around, but not, apparently, beyond the latitude of 50° or 40°; the equatorial band of 30° or 40° North or South being always free from snow-masses bright enough and large enough to catch the eye of the observer. Mars may, therefore, be inhabited, and we may see in the present state of this inquiry reason to pause before refusing the probability of any life to Jupiter and even more distant planets.

The history of suns and planets is in truth the history of the effects of light and heat manifested in them or emanating from them. Nothing in the universe escapes their influence; no part of space is too distant to be penetrated by their energy; no kind of matter is able to resist their transforming agency. Many, if not all, the special forces which act in the particles of matter are found to be reducible into the general form of heat; as this is convertible, and practically is converted, into proportionate measures of special energy. Under this comprehensive idea of convertibility of force, familiar to us now by the researches of Joule,[††] the reasonings of Grove[‡‡] and Helmholtz, and the theorems of Rankine,[§§] it has been attempted by Mayer, Waterston, and Thomson[‖‖] to assign a cause for the maintenance of the heat-giving power of the sun in the appulse of showers of aërolites and small masses of matter, and the extinction of their motion on the surface of the luminary. By calculations of the same order, depending on the rate of radiation of heat into space, the past antiquity of the earth and the future duration of sunshine have been expressed in thousands or millions of centuries.[¶¶] In like manner the physical

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[‡] The effect of lenses or globes of glass or crystal (ὕαλος) in collecting the solar rays to a point are familiarly referred to by Aristophanes in the Nubes, 766; and the ornamental use of convex and concave reflectors is known by the curious discussions in the IVth Book of Lucretius.

[§] Fizeau performed experiments on the velocity of light between Suresnes and the Butte Montmartre, by means of the oxyhydrogen light, reflected back in its own path. The space was 18,324 ft. Engl. Twice this distance was traversed in $\frac{1}{18000}$ of a second = 167,528 geogr. miles in a second. From observations of Jupiter's satellites, Delambre inferred 167,976 miles, Struve 166,096. The experiment of M. Foucault gives 298,000,000 metres = 160,920 geogr. miles.

[‖] Estimates of the earth's distance from the sun have varied much. Cassini and Flamsteed, using observations of the parallax of Mars, ascribe to it ten or eleven thousand diameters of the earth = 79 or 89 millions of miles. Huyghens estimated it at twelve thousand = 95 millions of miles. In 1745, Buffon reported it as the common opinion of astronomers at 30 millions of leagues (Fr.) = 90 millions miles (Engl.), but after the transit of Venus in 1769, he allowed 33 millions. Such was the effect of that now supposed erroneous experiment on the opinions of astronomers. (Époques de la Nature.)

[¶] Proc. of Roy. Soc. 1861. The Rumford Medal was adjudged to Dr. Tyndall in 1864.

[**] The proportion is about $\frac{100}{231}$ according to the received measure of the mean distance.

[††] *Phil. Mag.*, 1843; Reports of the British Association, 1845; *Trans.* of the Royal Society, 1850.

[‡‡] Grove, on the Correlation of Physical Forces, 1846.

[§§] Rankine, *Trans.* of the Royal Society of Edinburgh, 1850-1; *Phil. Trans.*, 1854.

[‖‖] Communication to the Royal Society of Edinburgh, 1854.

[¶¶] Professor Thomson assigns to the sun's heat, supposing it to be maintained by the appulse of masses of matter, a limit of [illegible] years; and to the period of cooling of the earth from universal fusion to its actual state 98,000,000 years. These are the lowest [illegible] sanctioned by any mathematician.

changes on the sun's disk, by which portions of his darkly heated body become visible through the luminous photosphere, have been connected, if not distinctly as a cause, certainly as a coincident phenomenon, with particular magnetic disturbances on the surface of the earth; the solar spots and the magnetic deflections concurring in periods of maxima and minima of ten or eleven years' duration. Thus even these aberrant phenomena become part of that amazing system of periodical variation which Sabine and his fellow-labourers, British, French, German, Russian, and American, have established by contemporaneous observation over a large part of the globe.[*]

With every change in the aspect and position of the sun, with every alteration in the place and attitude of the moon, with every passing hour, the magnetism of the earth submits to regular and calculable deviation. Through the substance of the ground, and across the world of waters, Nature, ever the beneficent guide to Science, has conveyed her messages and executed her purposes, by the electric current, before the discovery of Oersted and the magical inventions of Wheatstone revealed the secret of her work.

Even radiant light, in the language of the new philosophy, is conceived of by Maxwell[†] as a form of electro-magnetic motion. And thus the imponderable, all-pervading powers, by which molecular energy is excited and exchanged, are gathered into the one idea of restless activity among the particles of matter:—

> . . . æterno percita motu :

ever-moving and being moved, elements of a system of perpetual change in every part, and constant preservation of the whole.

What message comes to us with the light which springs from the distant stars, and shoots through the depths of space to fall upon the earth after tens, or hundreds, or thousands of years? It is a message from the very birthplace of light, and tells us what are the elementary substances which have influenced the refraction of the ray. Spectral analysis—that new and powerful instrument of chemical research for which we are indebted to Kirchhoff—has been taught by our countrymen to scrutinise not only planets and stars, but even to reveal the constitution of the nebulæ, those mysterious masses out of which it has been thought new suns and planets might be evolved—nursing-mothers of the stars. For a time, indeed, the resolution of some nebulæ, by the giant mirror of Lord Rosse, afforded ground for opposing the speculation of Herschel and the reasoning of Laplace, which required for their very starting point the admission of the existence of thin gaseous expansions, with or without points or centres of incipient condensation, with or without marks of internal movement. The latest results, however, of spectral analysis of stars and nebulæ by Mr. Huggins and Professor W. A. Miller, have fairly restored the balance. The nebulæ are, indeed, found to have in some instances stellar points, but they are not stars; the whole resembles an enormous mass of luminous gas, with an interrupted spectrum of three lines, probably agreeing with nitrogen, hydrogen, and a substance at present unknown.[‡] Stars tested by the same accurate hands are found to have a constitution like that of our own sun, and, like it, to show the presence of several terrestrial elements—as sodium, magnesium, iron, and very often hydrogen. While in the moon and Venus no lines whatever are found due to an atmosphere, in Jupiter and Saturn, besides the lines which are identical with some produced in our own atmosphere, there is one in the red, which may be caused by the presence of some unknown gas or vapour. Mars is still more peculiar, and enough is ascertained to discountenance the notion of his redness being due to a peculiarity of the soil.[§]

To aid researches into the condition of celestial bodies, the new powers of light, discovered by Niepce, Daguerre, and Talbot, have been employed by Bond, Draper, De la Rue, and other astronomers. To our countryman, in particular, belongs the honour of successful experiments on the rose-coloured flames which extend from certain points of the sun's border during an eclipse, as well as of valuable contributions through the same agency to that enlarged survey of the physical aspect of the moon which, since 1852, the Association has striven to promote. By another application of the same beautiful art in connection with clock-work, the momentary changes of magnetic force and direction, the variations of temperature, the fluctuations of atmospheric pressure, the force of the wind, the fall of rain, the proportion of ozone in the air, are registered in our observatories; and thus the inventions of Ronalds and his successors have engaged the solar rays in measuring and comparing contemporaneous phenomena of the same order over large parts of the globe—phenomena some of which are occasioned by those very rays.

As we ascend above the earth, heat, moisture, and magnetic force decrease, the velocity of wind augments, and the proportion of oxygen and nitrogen remains the same. The decrease of heat as we rise into the air is no new subject of inquiry, nor have the views respecting it been very limited or very accordant. Leslie considered it mathematically in relation to pressure; Humboldt gave the result of a large inquiry at points on the earth's surface, unequally elevated above the sea, and finally, Mr. Glaisher and Mr. Coxwell, during many balloon ascents to the zones of life-destroying cold, far above our mountain tops, have obtained innumerable data, in all seasons of the year, through a vast range of vertical height. The result is to show much more rapid decrease near the earth, much slower decrease at great elevations; thus agreeing in general with the view of Leslie, and yet throwing no discredit on the determinations of Humboldt, which do not refer to the free atmospheric ocean, but to the mere borders of it where it touches the earth, and is influenced thereby.[‖]

The proportion of carbonic acid gas in the atmosphere at great heights is not yet ascertained: it is not likely to be the same as that generally found near the earth; but its proportion may be more constant, since in those regions it is exempt from the influence of the actions and reactions which are always in progress on the land and in the water, and do not necessarily compensate one another at every place, and at every moment.

Other information bearing on the constitution of the atmosphere comes to us from the auroral beams and other meteoric lights known as shooting stars. For some of these objects not only appear at heights of 10, 50, and 100 or more miles above the earth, but at the height of 50 miles it is on record that shooting-stars or fire-balls have left waving trains of light, whose changes of form were in seeming accordance to varying pressure in the elevated and attenuated atmosphere.[¶]

Researches of every kind have so enriched meteorology since our early friend, Professor J. Forbes, printed his suggestive reports on that subject; and so great have been the benefits conferred on it by the electric telegraph, that

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[*] Among the interesting researches which have been undertaken on the subject of the spots, may be mentioned those of Wolf (*Comptes-Rendus* 1859), who finds the number and periodicity of the spots to be dependent on the position of Venus, the Earth, Jupiter, and Saturn. Stewart has made a special study of the relation of the spots to the path of Venus (*Proc.* of the Roy. Soc. 1864); and Chacornac is now engaged in unfolding his conception of the spots as the visible effects of volcanic excitement. The peculiar features of the solar surface are under examination by these and other good observers, such as Dawes, Nasmyth, Secchi, Stone, Fletcher, and Lockyer.

[†] *Proceedings* of Royal Society, 1864. The elder Herschel appears to have regarded the light of the sun and of the fixed stars as perhaps the effect of an electro-magnetic process—a perpetual aurora.

[‡] *Proceedings* of Royal Society and *Philosophical Transactions*, 1864.

[§] *Philosophical Transactions*, 1864.

[‖] Reports of the British Association for 1862, 1863, 1864.

[¶] This is the result of a careful discussion made by myself of observations on a meteor seen from Rouen to Yorkshire, and from Cornwall to Kent, January 7, 1865.

at this moment in M. Leverrier's observatory at Paris, and the office so lately presided over by Admiral Fitzroy in London, the messages are arriving from all parts of Europe to declare the present weather, and furnish grounds for reasonable expectation of the next probable change. Hardly now within the seas of Europe can a cyclone begin its career of devastation, before the warning signal is raised in our sea-ports, to restrain the too confident sailor. The gentle spirit which employed this knowledge in the cause of humanity has passed away, leaving an example of unselfish devotion, in a work which must not fail through any lack of energy on the part of this Association, the Royal Society, or the Government. We must extend these researches and enlarge these benefits by the aid of the telegraph bringing the ends of the world together. Soon may that thread of communication unite the two great sections of the Anglo-Saxon race, and bring and return through the broad Atlantic the happy and mutual congratulations for peace restored and friendships renewed.

The possible combinations of force by which, in the view we have been considering, the characteristic forms and special phenomena of solid, liquid, and gaseous matter are determined, may be innumerable. Practically, however, they appear to be limited, as natural products, to less than 1000 distinguishable compounds, and less than 100[**] elementary substances. Of these elements the most prevalent are few on the earth; as of gases, oxygen, hydrogen, nitrogen: of solids, silicon, calcium, magnesium, sodium, iron; and it is interesting to learn by analysis of the light of stars and planets, that these substances, or some of them, are found in most of the celestial objects yet examined, and that, except in one or two instances, no other substances have been traced therein. Even the wandering meteoric stones, which fall from their courses, and are examined on the earth, betray only well-known mineral elements, though in the manner in which these are combined, some differences appear, which by chemical research and the aid of transparent sections Professor Maskelyne and Mr. Sorby are engaged in studying and interpreting.[††]

By the labours of Lavoisier and his contemporaries, chemistry acquired a fixed logic and an accurate nomenclature. Dalton and the great physicists of the early part of this century gave that law of definite combination by proportionate weights of the elements which is for chemistry what the law of gravitation is for celestial mechanics. A great expansion of the meaning of the atomic theory took place, when Mitscherlich announced his views of isomorphous, isomeric, and dimorphous bodies. For thus it came gradually to appear that particular forces resided in crystals in virtue of their structure, lay in certain directions, and exhibited definite physical effects, if the chemical elements, without being the same, were combined in similar proportions, and aggregated into similar crystals. Some years later, ozone was discovered by Schönbein, and it concurred with a few other allotropic substances in reviving, among philosophic chemists, the inquiry as to the relative situation of the particles in a compound body, and the effects of such arrangements: an idea which had been expressed by Dalton in diagrams of atoms, and afterwards exercised the ingenuity of Exley, MacVicar, and others.[‡‡]

Everything connected with this view of the modification of physical properties by the arrangement of the particles—whether elementary or compound—is of the highest importance to mineralogy, a branch of study by no means so much in favour even with chemists as its own merits and its collateral bearings might justly deserve. Yet it is in a great measure by help of this branch of study that the opinions now current regarding metamorphism of rocks *in situ*, and the formation of mineral veins, must acquire that solid support and general consent which at present they do not possess. Crystals, indeed, whether regarded as to their origin in nature, their fabrication by art, or their action on the rays of light, the waves of heat and sound, and the distribution of electricity, have not been neglected by the Association or its members. In one of the earliest reports, Dr. Whewell calls attention to the state of crystallographical theory, and to the artificial production of crystals; and in another report, Professor Johnston notices epigene and pseudomorphous crystallisation; and for many years, at almost every meeting, new and brilliant discoveries in the action of crystals on light were made known by Brewster,[§§] and compared with the undulatory theory by Herschel, MacCullagh, Airy, Hamilton, Whewell, Powell, Challis, Lloyd, and Stokes.

The unequal expansion of crystals by heat, in different directions, first observed by Mitscherlich, has been carefully examined in the cases of sulphate and carbonate of lime by Professor W. H. Miller,[‖‖] who has also considered their elasticity, originally measured in different relations to the axis by Savart. These and many other interesting relations of crystals have been attended to; but the Association has not yet succeeded in obtaining a complete digest of the facts and theories connected with the appearance of crystals in nature—in the fissures of rocks; in the smaller cavities of rocks; in the solid substance or liquid contents of other crystals. Such an inquiry, however, it did earnestly demand, and some steps have been taken by our own chemists, mineralogists, and geologists. But more abundant information on this class of subjects is still needed, even after the admirable contributions and recent discoveries of Bischoff, Delesse, and Daubrée.[¶¶]

Within our Association-period both the nomenclature of chemistry and the conception of the atomic theory have received not indeed a change, but such an addition to its ordinary expression as the more general language and larger meaning of algebra have conferred on common arithmetical values. The theory of compound radicals, as these views of Liebig, Dumas, and Hofmann may be justly termed, embraces the consideration of groups of elements united in pairs by the ordinary law, these groups being for the purpose in hand treated as single elements of combination. The nomenclature which attempts in ordinary words to express these relations grows very unmanageable even in languages more easily capable of polysyllabic combinations than ours; but symbols of composition—the true language of chemistry—are no more embarrassed in the expression of these new ideas, than are the mathematical symbols which deal with operations of

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[**] At the present moment the number of "elementary substances" is sixty-one.

[††] Professor Maskelyne has made a convenient classification of the large collection of meteorites in the British Museum, under the titles of "Aërolite or Meteoric Stone;" "Aërosiderite or Meteoric Iron;" and "Aërosiderolites," which includes the intervening varieties. Mr. Sorby, whose latest results are unpublished, but will be communicated to the Royal Society, is of opinion that the substance of meteorites has undergone changes due to physical conditions in some ancient period not now to be paralleled on our planet, or on the moon, but rather to be looked for only in the immediate neighbourhood of the sun. Professor Haidinger has also made a special study of meteorites.

[‡‡] Dalton, Chemistry, vol. i. 1808. A clear view of the simpler applications of Dalton's ideas is given by the illustrious author in Daubeny's Treatise on the Atomic Theory, 1850.

Exley, Nat. and Exp. Philosophy, 1829.

MacVicar, Reports of the British Association for 1855.

[§§] "Sir David Brewster must be considered as in a degree the creator of the science which studies the mutual dependence of optical properties and crystalline forms."—(Whewell, in Report on Mineralogy, Brit. Association, 1882, p. 836.)

[‖‖] Rep. Proc., 1837, pp. 43 and 44.

[¶¶] Bischoff, "Chemical Geology," (published by the Cavendish Society, 1856.) Delesse, "Etudes sur le Métamorphisme," 1858, and other works. Daubrée, "Sur la Relation des Sources Thermales de Plombières avec les Filons Metallifères et la Formation des Zeolithes," 1858, and other works.

much greater complexity on quantities more various and more variable.* The study of these compound radicals comes in aid of experimental research into those numerous and complex substances which appear as the result of chemical transformations in organic bodies. Thus, in some instances the very substances have been recomposed by art which the vital processes are every moment producing in nature; in others the steps of the process are clearly traced; in all the changes become better understood through which so great a variety of substances and structures are yielded by one circulating fluid; and the result is almost a new branch of animal and vegetable physiology, not less important for the health of mankind than essential to the progress of scientific agriculture.

(To be continued.)

ACADEMY OF SCIENCES.

August 28.

M. Damour concluded his account of the minerals which have been employed for stone implements. In this part the author describes a stone of which many implements have been formed, and to which he gives the name *Chloromelanite*. The stone appears to be black, but a thin section held up to the light is seen to be green. M. Damour regards it as a variety of jadeite in which a portion of alumina is replaced by ferric oxide. Implements of this stone have been found in various parts of France, in Mexico, and in New Granada, but the author knows of no locality in which the rock occurs.

M. Filhol presented a "*Note on the Chemical Properties of Chlorophyll.*" The author states that pure chlorophyll cannot be obtained by any of the processes hitherto published; and he goes on to describe the changes produced in this body by acids, both mineral and organic.

The copy of the *Comptes-Rendus* sent to us is unfortunately imperfect, and we are unable to give a complete abstract of M. Filhol's note this week. For the same reason we can only give the title of a paper by M. Bechamp, "*On the Fermentation of Normal Urine, and the Substances Capable of Setting it up*," and of another, by M. Blondeau, "*On Two New Pyroxylins.*" We are told briefly in *Les Mondes* that one of these bodies is produced by the addition of ammonia to cotton, and a mixture of nitric and sulphuric acids; the other by treating ordinary pyroxylin with hydrochloric acid.

M. Lorin communicated a process for "*The Manufacture of Concentrated and Monohydrated Formic Acid.*" The author finds that by distilling glycerine saturated with dehydrated oxalic acid, a solution of formic acid containing 75 per cent. of real acid is obtained. The heat must be carefully managed to prevent frothing; the oxalic acid begins to decompose at 50°. To remove the water from this solution, the author again employs anhydrous oxalic acid. On distilling the mixture crystallisable formic acid is procured. The small space at our disposal this week obliges us to defer a longer account of the author's experiments.

M. Lorin also communicated "*A new Method of Preparing Formic Ethers.*" To produce these the glycerine and oxalic acid is distilled with the alcohol corresponding to the ether desired. The vapours at first should be carried back to the retort, and the distillation not proceeded with until some time after the decomposition of the oxalic acid is complete. The ethers may be purified in the ordinary way. 500 grammes of amylic alcohol gave the same weight of amyl-formic ether.

Professorship of Organic Chemistry.—An Imperial decree institutes a Professorship of Organic Chemistry at the Collége de France, to which M. Berthelot has been appointed. A better choice it would have been impossible to make.

NOTICES OF BOOKS.

Diarrhœa and Cholera; their Origin, Proximate Cause, and Cure, through the Agency of the Nervous System, by Means of Ice. By John Chapman, M.D., &c., &c. London: Trübner and Co. 1865. Pp. 46.

We may earnestly commend this little book to the attention of all our readers, medical and non-medical. At the present time it is well for every one to know how to employ a simple, safe, and effective remedy for diarrhœa and cholera.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

1946. T. Pepper, Newington Green, Middlesex, "Improvements in the manufacture of anti-flammable starch."—Petition recorded July 26, 1865.

1952. H. Sherwood, Hatcham, Surrey, "Improvements in the means of and apparatus for heating animal and vegetable fibrous materials, which apparatus is also applicable to various useful purposes."—July 27, 1865.

1964. E. Sabel, Moorgate Street, "Improvements in the manufacture of iron." A communication from M. D. Henvaux, St. Servais, near Namur, Belgium.—July 29, 1865.

2085. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the manufacture of candles." A communication from C. Goublier, Paris.—August 11, 1865.

2095. H. Woodward, Cannon Street, "Improvements in carburetting coal-gas, and manufacturing artificial gas, and in the machinery or apparatus employed therein."—August 12, 1865.

2105. J. F. Boetius, Smethwick, Staffordshire, "Improvements in furnaces to be used in the manufacture of glass, and iron, and steel, and for other like purposes." A communication from H. Boetius, Schauenstein, near Obernkirchen, Germany.—August 15, 1865.

2113. J. Smith, Baxenden, and W. Schofield, Heywood, Lancashire, "Improvements in machinery used in washing, bleaching, and dying yarn and textile fabrics in the hank."—August 16, 1865.

Inventions Protected by the Deposit of Complete Specifications.

2153. G. G. Dennis, Boston, Suffolk, Mass., U.S.A., "Improvements in friction matches, lucifer matches, and matches for re-lighting called 'taper matches.'"—August 21, 1865.

2203. H. A. Bonneville, Rue du Mont Thabor, Paris, "Improvements in the construction of apparatus for distilling and rectifying alcohols." A communication from F. D. Savalle, Boulevard Magenta, Paris.—August 28, 1865.

Notices to Proceed.

1011. A. G. Hunter, Rockcliff Hall, near Flint, "Improvements in the manufacture of soda and potash."—Petition recorded April 8, 1865.

1049. J. S. Bickford, Camborne, Cornwall, "The manufacture of an improved safety fuse."—April 12, 1865.

1154. J. N. Brown, Handsworth, Staffordshire, and T. D. Clare, Birmingham, "Improvements in paints or compositions for coating and preserving metallic and other substances from oxidation and decay."

1161. W. Clark, Chancery-lane, "Improvements in the manufacture of soluble and assimilable superphosphates of lime by the application of phosphoric acid and acid phosphates."—A communication from L. H. Blanchard and T. Chateau, Boulevart St. Martin, Paris.—April 25, 1865.

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* "On the Nomenclature of Organic Compounds," by Dr. Daubeny. Reports of British Association, 1851.

1186. D. Simpson, Monkland Cottage, Airdrie, Lanarkshire, N.B., "Improvements in furnaces."—April 27, 1865.

1217. F. Wise, Chandos Chambers, Adelphi, "A mode of obtaining decoctions, and apparatus for carrying the same into effect."—A communication from B. G. Martin, Philadelphia, U.S.A.—May 2, 1865.

1255. W. Henderson, Glasgow, "Improvements in extracting copper and several other metals from certain ores of these metals."—May 5, 1865.

1313. A. Parkes, Birmingham, "Improvements in the manufacture of parkesine, or compounds of pyroxyline, and also solutions of pyroxyline known as collodion."—May 11, 1865.

1412. H. Wilde, Manchester, "Improvements in the production and application of electricity."—May 23, 1865.

1554. A. C. Henderson, Charing-cross, "Improvements in tanning hides, and in apparatus connected therewith."—A communication from E. S. Beaux and E. Pannifex, Paris.—June 7, 1865.

1962. F. A. Abel, Woolwich, Kent, "Improvements in compounds for waterproofing and insulating purposes."—July 29, 1865.

MISCELLANEOUS.

The Murrain.—We have noticed several communications in the daily papers suggesting the treatment of the cattle disease by the injection of what is printed *sulphate* of soda. The writers no doubt mean *sulphite* of soda, the efficacy of which in the treatment of blood diseases has been established by Dr. Polli. The remedy is certainly worthy of a trial. An account of Dr. Polli's experiments will be found in the Chemical News, vol. v., p. 230.

Manufacture of Magnesium.—The "American Magnesium Company" of this city have just commenced the manufacture of magnesium from dolomite or magnesian limestone by the Sonstadt method, and are producing the metal, both crude and refined, in considerable quantities. The principal use of this hitherto very rare metal is to burn for light. It is burned in the form of fine wire. The light is (1) achromatic, (2) intense, (3) has good actinic properties, and is (4) very penetrating. Hence (1) colours can be distinguished as in sunlight, (2) a wire a hundredth of an inch in diameter gives a light equal to seventy-four stearine candles, (3) actinograms [ambrotypes and the like] can be taken as by daylight, and (4) the light can be seen twenty-eight miles at sea. Its actinic power is shown by the fact that while its intensity is but 1-525th that of the sun at noon on November 13, its photographic power is 1-36th that of the sun. The heat it yields in burning is infinitesimal compared with gas, oil, or candles. In cloudy England the wire has for some months been sold to photographers at two dimes per inch.—*Boston Recorder.*

Detection of Nitrobenzol in Oil of Bitter Almonds.—A clean piece of sodium placed in pure oil of bitter almonds causes a slight evolution of gas, and the metal becomes covered with a white flocculent coating. If alcohol is present, the evolution of gas is greater and the white coating falls away from the metal. Pure nitrobenzol similarly treated with sodium gives off a little gas, darkens but very slightly, and no white flocculi separate. But if a very small amount of alcohol is present with the nitrobenzol, an active evolution of gas takes place, and the liquid very quickly becomes of a dark brown or even black colour. Ten per cent. of alcohol can easily be recognised in this way. To detect nitrobenzol in bitter almond oil, Dragendorff adds four or five drops of alcohol to ten or fifteen drops of the suspected oil, and places a piece of clean sodium in the mixture. If nitrobenzol is present the metal becomes covered with a yellow or brown coating, the colour being darker as the proportion of nitrobenzol is greater.—*Zeitscht. für Analyt. Chem.*, No. 4, 1864, p. 478.

A New Classification of Odours.—

Classes.	Types.	Odours belonging to the same Class.
Rose	Rose	Geranium, Sweetbriar, Rhodium, Rosewood.
Jasmine	Jasmine	Lily of the Valley.
Orange Flower	Orange Flower	Acacia, Syringa, Orange leaves.
Tuberose	Tuberose	Lily, Jonquil, Narcissus, Hyacinth.
Violet	Violet	Cassie, Orris-root, Mignonette.
Balsamic	Vanilla	Balsam of Peru and Tolu, Benzoin, Styrax, Tonquin Beans, Heliotrope.
Spice	Cinnamon	Cassia, Nutmeg, Mace, Pimento.
Clove	Clove	Carnation, Clove Pink.
Camphor	Camphor	Rosemary, Patchouly.
Sandal	Sandalwood	Vetivert, Cedarwood.
Citrine	Lemon	Bergamot, Orange, Cedrat, Limette.
Lavender	Lavender	Spike, Thyme, Serpolet, Marjoram.
Mint	Peppermint	Spearmint, Balm, Rue, Sage.
Aniseed	Aniseed	Badiane, Carraway, Dill, Coriander, Fennel.
Almond	Bitter Almonds	Laurel, Peach, Kernels, Mirbane.
Musk	Musk	Civet, Musk-seed, Musk-plant.
Amber	Ambergris	Oak-moss.
Fruit	Pear	Apple, Pine-apple, Quince.

—*Rimmel's Book of Perfumes.*

Egyptian Kohl.—The kohl, or kheul, which we have seen in use for darkening the eyelids since the time of the ancient Egyptians, is made by the Arabs in the following way:—They remove the inside of a lemon, fill it up with plumbago and burnt copper, and place it on the fire until it becomes carbonised; then they pound it in a mortar with coral, sandalwood, pearls, ambergris, the wing of a bat, and part of the body of a chameleon, the whole having been previously burnt to a cinder, and moistened with rose-water whilst hot.—*Ibid.*

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. *Private* letters for the Editor must be so marked.

Vol. XI. of the Chemical News, containing a copious Index, is now ready, price 11s. od., by post, 11s. 6d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. XII. commenced on July 7, 1865, and will be complete in 26 numbers.

J. J.—The recommendation of Fellows from personal knowledge; 2*l.* annually or a composition.

B. W. G. is thanked. We have already published articles on the subject.

J. F.—Rub the plaster and carbonate of soda together in a mortar; add some spirit of wine, which will dissolve the oleate of soda, and leave the carbonate of lead. Evaporate the solution of soap to get rid of the spirit of wine, and use the soap left.

Books Received.—"Anniversary Address delivered before the Anthropological Society of London," by Jas. Hunt, Ph.D., &c.; "[illegible] Gossip."

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Preliminary Note on a New British Mineral containing Cerium, by A. H. Church, *M.A.*

During a recent visit to Cornwall I obtained from Mr. Talling, of Lostwithiel, a small specimen of a mineral which seemed to be worthy of examination. Mr. Talling himself had always been of the same opinion since he first met with the specimen, and it is to his sagacity and perseverance that British mineralogy owes a new and most interesting species.

The mineral is distinctly crystallised, and occurs as a coating of not more than one-tenth of an inch in thickness, upon a siliceous matrix in which a grey-green mineral resembling hornblende is disseminated.

The crystalline form of the mineral appears to be that of an oblique rhombic prism. The crystals are arranged in fan-shaped groups, so that only one of the end-faces of the prism can be examined. This upper end-face (001, if I have read the crystal aright) has a brilliant lustre, almost adamantine, and the easiest cleavage of the crystal is parallel to it. The acute prismatic edges of the crystal are symmetrically truncated by small planes. The hardness of the mineral is about 3. It is transparent and pale smoke-grey.

The mineral was carefully picked over, and half the specimen, about one gramme, submitted to analysis. With this small amount, the quantitative results are accordant and satisfactory.

Qualitative analysis showed the presence of phosphoric acid, lime, water, and an earth resembling alumina. But it was soon found that this, as precipitated by ammonia, was really the hydrate of cerium, or rather of the mixed oxides of cerium, lanthanium, and didymium. The insoluble oxalate, the double cerous-potassic sulphate, the borax bead, orange yellow when hot, and all the other characteristics of the cerium group, were readily obtained from minute fragments of the mineral. The following mean percentages are deduced from seven determinations; two of P_2O_5, two of $Ce''O$, two of H_2O, and one of $Ca''O$.

Experiment.

P_2O_5	28·49
$Ce''O$	51·97
$Ca''O$	5·49
H_2O	14·93
	100·88

The mineral is, then, a hydrated phosphate of cerium and calcium, for I have been led to the opinion that the calcium is here not an intruding but an essential element. The known phosphates of cerium are monazite and cryptolite; the latter contains no calcium, the former less than 2 per cent. calcium, while in neither of these minerals is there any water.

From the analyses may be deduced the formula

$$Ce''_5Ca''\ PO_4,8aq,$$

which demands the following percentages:—

P_2O_5	27·73
$Ce''O$	52·73
$Ca''O$	5·47
H_2O	14·07
	100·00

Adopting the older atomic weights, the mineralogical formula may be abbreviated thus,—

$$(\dot{Ce}_{\frac{5}{6}}\dot{Ca}_{\frac{1}{6}})_3\,\overline{\dddot{P}} + 4\dot{H}.$$

In the course of a few weeks further details regarding the properties, &c., of the new cerium mineral will be published.

Laboratory, R.A. College, Cirencester, September 9.

PHARMACY, TOXICOLOGY, &c.

Oxygenated Saline Waters, by B. W. Richardson, *M.A., M.D., London.*

Dr. Richardson laid before the British Medical Association specimens of oxygenated saline waters. In these solutions he had succeeded in combining peroxide of hydrogen (containing ten volumes of active oxygen) with various saline substances, and especially with salts of iron. The waters, when properly diluted, were almost tasteless, the taste being so unobjectionable that children could take them, and adults could drink them at meals in place of common water or other fluid. The solutions presented were, a diuretic water carrying nitrate of potassa and spirit of nitric ether; a simple aperient water, conveying sulphate of potassa; and two chalybeate saline waters, one containing phosphate, the other persulphate, of iron, with a little free oxide of iron. The waters were all mildly aperient. They were used for adults in proportions of two ounces for a dose, ordinary water being added so as to fill a tumbler. Specimens were diluted in this way and handed to the members. Dr. Richardson said that the water containing the persulphate of iron was the best chalybeate aperient he had ever used. It remained fresh for weeks, and in appearance resembled to perfection a natural mineral chalybeate water. It differed, however, from such water in that it contained a little sugar and was rich in oxygen. Each dose contained a grain of the iron salt. The formula for this water was as follows:—

Peroxide of hydrogen (Ten volumes of oxygen.)	℥i.
Sulphate of potassa	ʒij.
Chloride of sodium	ʒiss.
Sulphate of iron	grs. xij.
Simple syrup	℥i.
Water to	℥xxiv.

Dose: Two fluid ounces to be taken with as much water as will fill a tumbler.

In obstinate cases of constipation with anæmia, and in cases of asthenic gout this solution was most useful. The advantages derived from the peroxide of hydrogen in these waters were most important, the peroxide quickening the eliminative action, and producing free secretion and excretion.

In reply to a question as to the manufacture of these waters, Dr. Richardson said that any Practitioners who had the peroxide of hydrogen could make the waters for themselves, but they were very efficiently made by Messrs. Garden and Robbins, of Oxford-street, London.

PROCEEDINGS OF SOCIETIES.

COLLEGE OF PHYSICIANS.

"*On Animal Chemistry.*" A course of Six Lectures by William Odling, M.B., F.R.S., F.R.C.P.

Wednesday, May 10, 1865.

Lecture 5.

(*Continued from page 115.*)

Some of these intermediate products of tissue metamorphosis, more particularly the hippuric and uric acids, leucine, and tyrosine, are of sufficiently constant occurrence

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and general interest to deserve our special examination. Hippuric acid we have already discussed somewhat fully, while the consideration of uric acid I must postpone to my next lecture. There remain, then, only leucine and tyrosine; but, before adverting to the natural occurrence of these bodies in the living and dead body, let me direct your attention for a short time to certain allied products obtainable from nitrogenous tissue by artificial processes. When flesh, for instance, is submitted to the action of the oxidising agent most commonly employed by chemists—namely, a mixture of sulphuric acid with either bichromate of potassium, or peroxide of manganese—there are produced a considerable number of monobasic acids, and several of their associated aldehydes and nitriles. The relationship of an aldehyd to its corresponding acid and alcohol is very simple, and may be exemplified by common or vinic aldehyd among fatty, and by benzoic aldehyd among aromatic compounds. Thus, when vinic alcohol is submitted to oxidation, it does not simply take up an additional dose of oxygen, but instead gives up a portion of its hydrogen to the oxygenant, being thereby converted into al*cohol* dehy*drogenatus* or aldehyd, thus:—

$$\begin{array}{ccccccc}\text{Alcohol.} & & \text{Oxygen.} & & \text{Water.} & & \text{Aldehyd.}\\ C_2H_6O & + & O & = & H_2O & + & C_2H_4O.\end{array}$$

The resulting aldehyd is a much more readily oxidisable substance than the original alcohol, and, upon exposure to air, is rapidly convertedby direct absorption of oxygen into acetic acid, thus:—

$$\begin{array}{ccccc}\text{Aldehyd.} & & \text{Oxygen.} & & \text{Acetic acid.}\\ C_2H_4O & + & O & = & C_2H_4O_2.\end{array}$$

Similarly, benzyl alcohol is not susceptible of mere oxidation, but, by the action of oxygenants, is dehydrogenised into benz-aldehyd, or essential oil of bitter almonds,—

$$\begin{array}{ccccccc}\text{Benzyl-alcohol.} & & \text{Oxygen.} & & \text{Water.} & & \text{Benz-aldehyd.}\\ C_7H_8O & + & O & = & H_2O & + & C_7H_6O;\end{array}$$

which, upon exposure to air, quickly changes by a direct absorption of oxygen into benzoic acid, thus:—

$$\begin{array}{ccccc}\text{Benz-aldehyd.} & & \text{Oxygen.} & & \text{Benzoic acid.}\\ C_7H_6O & + & O & = & C_7H_6O_2.\end{array}$$

Oxygen, then, which removes hydrogen from the alcohols, attaches itself directly to the aldehydes, and thereby distinguishes the one class of compounds from the other; even when, as in the case of allyl alcohol and propionic aldehyd, the two bodies have the same ultimate composition, represented in their case by the formula C_3H_6O. Now, although the characteristic property of the aldehydes is to absorb oxygen with conversion into acids, they may nevertheless be rehydrogenised into alcohols, as by the process of Wurtz referred to in my last lecture, thus:—

$$\begin{array}{ccccc}\text{Benz-aldehyd.} & & \text{Hydrogen.} & & \text{Benzyl-alcohol.}\\ C_7H_6O & + & H_2 & = & C_7H_8O.\end{array}$$

Or, still more curiously, one moiety of the reacting aldehyd may be oxidised into the corresponding acid or its salt, and the other moiety simultaneously hydrogenised into the alcohol, as in Cannizzaro's well-known process:—

$$\begin{array}{ccccccc}\text{Benz-aldehyd.} & & \text{Potash.} & & \text{Pot. benzoate.} & & \text{Benzyl-alcohol.}\\ 2C_7H_6O & + & KHO & = & C_7H_5KO_2 & + & C_7H_8O\end{array}$$

Correlated, then, with every alcohol and acid is an intermediate aldehyd, several of which bodies, in addition to benz-aldehyd, are familiarly known to us in the form of essential oils. Thus, essential oil of chamomile contains angelic aldehyd convertible by exposure into angelic acid. Oil of cinnamon, again, contains cinnamic aldehyd convertible by exposure into cinnamic acid. Oil of spiræa constitutes salicic aldehyd convertible by oxidation into salicic acid; while oil of rue contains methyl-rutic aldehyd, convertible by oxidation into rutic acid. Moreover, the bodies known as acroleine, acetone, propione, glyoxal, &c., belong to the same class of compounds, all of which are characterised by the property of forming sparingly soluble crystalline compounds with the acid- or bi-sulphites of alkali-metal (Bertagnini). Thus, on mixing a solution of acid-sulphite of sodium with the product of the destructive distillation of castor oil, which contains the 7-carbon or œnanthic aldehyd, the whole becomes, you observe, a semi-solid white mass, from the instantaneous combination of the two bodies with one another to form œnanthal-sulphite of sodium $C_7H_{14}O.HNaSO_3$. But even this property of uniting with the acid sulphites, which enables us so easily to recognise and isolate the aldehydes, is less characteristic than their acidifiability by direct absorption of oxygen; so that, considered as products of oxidation, the aldehydes may be looked upon as incompletely formed acids. When, therefore, we find that by treating muscle with an oxidising agent we obtain aldehydes together with their corresponding acids, it only shows that our oxidising agent is employed in deficiency, or rather that the products, being readily volatile, are not left in contact with the heated oxidising mixture sufficiently long to be entirely converted into acids.

But in addition to aldehydes and acids, certain nitriles, more particularly formio-nitrile and valero-nitrile, have been obtained by muscle oxidation. You may remember that I have already, in previous lectures, made mention of prussic acid, cyanide of hydrogen, or formio-nitrile; of cyanide of methyl, or aceto-nitrile; of cyanogen, or oxalo-nitrile, &c. Now, the majority of nitriles are procurable either by the action of the simplest organic nitrile, namely, formio-nitrile or prussic acid, upon the preceding alcohol, or by the action of ammonia upon the co-equal acid, with elimination of water, as shown below in the case of valero-nitrile:—

$$\begin{array}{ccccccc}\text{Butyl alcohol.} & & \text{Prussic acid.} & & \text{Water.} & & \text{Valero-nitrile.}\\ C_4H_{10}O & + & CHN & - & H_2O & = & C_5H_9N.\\ \text{Valeric acid.} & & \text{Ammonia.} & & \text{Water.} & & \text{Valero-nitrile.}\\ C_5H_{10}O_2 & + & H_3N & - & 2H_2O & = & C_3H_9N.\end{array}$$

The first process is a true synthesis, or passage from a lower to a higher carbon group, as explained in my last lecture when speaking of general synthetic methods; while the second is merely a metamorphosis of the acid into its dehydrated ammonia salt. By treatment with caustic alkalies, the several nitriles or organic cyanides absorb water to reproduce ammonia and a salt of the acid to which they respectively appertain, thus:—

$$\begin{array}{ccccccccc}\text{Valero-nitrile.} & & \text{Potash.} & & \text{Water.} & & \text{Ammonia.} & & \text{Pot. valerate.}\\ C_5H_9N & + & KHO & + & H_2O & = & H_3N & + & C_5H_9KO_2.\\ \text{Prussic acid.} & & \text{Potash.} & & \text{Water.} & & \text{Ammonia.} & & \text{Pot. formiate.}\\ CHN & + & KHO & + & H_2O & = & H_3N & + & CHKO_2.\end{array}$$

Accordingly, the occurrence of nitriles in addition to acids and aldehydes, only shows that certain oxidation-products of the carbo-hydrate constituents of muscle exist partly in combination with an ammonia-residue derived from its nitrogenous constituents, whereby, instead of the normal acids, we obtain in some cases their dehydrated ammonia salts; whence it follows that the nitriles, like the aldehydes, do not call for any separate consideration, but may be discussed with their respective acids, of which, indeed, they constitute mere varieties.

The following acids, then, in the state of acids, aldehydes, and nitriles, have been obtained by the oxidation of flesh with a mixture of sulphuric acid, and peroxide of manganese,—as now taking place in the retort upon the table:—

Fatty Acids.		Aromatic Acids.	
$C_6H_{12}O_2$	Caproic	—	,,
$C_5H_{10}O_2$	Valeric	—	,,
$C_4H_8O_2$	Butyric	—	,,
$C_3H_6O_2$	Propionic	$C_8H_8O_2$	Toluic?
$C_2H_4O_2$	Acetic	$C_7H_6O_2$	Benzoic
CH_2O_2	Formic	$C_6H_4O_2$	Collic?

These several acids, you observe, contain but two atoms of carbon in their respective molecules. In reality, however, we cannot doubt that corresponding acids with three and four atoms of oxygen are also formed, as in other modes of oxidation; but these poly-oxygen acids being much less volatile than their di-oxygen congeners, are not removed at once from the oxidising mixture, but remain in contact with it for so great a length of time—are subjected to such a prolonged process of oxidation—that they become more or less completely destroyed, or, in other words, converted into carbonic acid.

Now, there are two special points of interest connected with the above list of muscle-acids, which are arranged, you observe, in the order of simplicity, instead of complexity, as heretofore. The first point to which I would direct your attention is, that even the most complex of these acids is comprised among the simpler members of its particular series. Thus, while by the direct or indirect oxidation of fat, we may obtain acids with eight, nine, ten, and even sixteen atoms of carbon, the most complex acids as yet obtained by the artificial oxidation of flesh, are those with five, six, and seven atoms, for the production of toluic acid is at any rate very doubtful. Now, although this oxidation of flesh has not been performed with sufficient frequency or variety of process to warrant our laying much stress upon the results obtained, still less of affirming that no more complex aplone molecules than those with seven atoms of carbon are in any case procurable, nevertheless the above observation, taken in conjunction with other facts, has an interest which must not be overlooked. Thus among all the products of tissue-metamorphosis occurring in the living body, with the possible exception of indigo, which, like toluic acid, contains eight carbon atoms; among all the products of the putrefactive decomposition of dead animal tissue; among all the products obtainable by its direct oxidation as just referred to; and among all the products obtainable by its indirect oxidation with acids or alkalies, not a single aplone molecule with more than seven atoms of carbon has yet been positively observed. Comparing the ascertained constitution of oleine, for instance, with the hypothetical constitution of some protein body, we know that the molecule of oleine contains 57 carbon atoms, and that these atoms pertain to the residues of four distinct aplone molecules, namely, three molecules of oleic acid, containing each 18 carbon atoms, and one molecule of glycerine, containing 3 carbon atoms. Accordingly, by the breaking up of oleine we may obtain aplone molecules with as many as 18 atoms of carbon, and with successively fewer and fewer atoms, according to the degree of oxidation, until finally we get such bodies as succinic acid $C_4H_6O_4$, oxalic acid $C_2H_2O_4$, and carbonic acid CH_2O_3; while, among intermediate compounds, the palmitic acid with 16, the sebacic and rutic acids with 10, and the suberic acid with 8, are certainly, and other acids with from 1 to 18 carbon atoms, in all probability, procurable. On the other hand, the composition of the molecule of albumen is at present undetermined, but assuming, according to the balance of authority, that it contains 72 carbon atoms, what is the number and what the complexity of the aplone molecules between which these 72 carbon atoms are divided? All we can say is that no aplone molecule with more than 7 or 8 carbon atoms has hitherto been produced by its natural or artificial decomposition, so that its constituent residues probably appertain to simpler molecules, than do the residues of ordinary fat.

The other point of interest connected with the artificial oxidation of flesh is, that the acids and aldehydes produced thereby belong to both our primary series, namely, the fatty and the aromatic; so that while the oxidation of muscle in the laboratory yields us the same series of fatty acids that are producible by the similar oxidation of fat, it yields in addition certain acids of the aromatic series which are not producible by the oxidation of fat. This result acquires additional importance from the consideration that chemists are at present quite unable to transform fatty into aromatic compounds, or *vice versa*, by any definite reaction. It is true that when certain bodies of the fatty class are subjected to a full red heat, some products belonging to the aromatic class are formed; but this transformation is one which we cannot trace. It belongs to that class of reactions which are called destructive or indefinite, in contra-distinction to those easily traceable and definite reactions which we call more especially metamorphic. By no ordinary treatment with reagents, and certainly not by any of the modes of treatment to which muscle has been subjected, are we able to pass from the fatty to the aromatic class of bodies; and accordingly, when we find, by treating flesh, &c., with sulphuric acid and manganese, that both aromatic and fatty acids are produced, we have a right to infer that, be the exact composition of flesh, &c., what it may, it certainly contains, in addition to its ammonia residues, one or more residues of compounds belonging to the fatty, and one or more residues of compounds belonging to the aromatic class. This conclusion becomes even more irresistible when we consider that not only by the direct oxidation of nitrogenous tissue now taking place on the table, but by its indirect oxidation, through the agency of acids and alkalies, as well as by its post-mortem putrefactive decomposition, and its antemortem natural transformation, compounds belonging to both the aromatic and fatty class simultaneously make their appearance.

Among these compounds, leucine and tyrosine demand our special attention—leucine being an ammoniated term of the 6-carbon fatty, and tyrosine an ethyl-ammoniated term of the 7-carbon aromatic acid group. These two bodies occur in association with one another under the following circumstances:—In the first place, they result from the putrefaction of flesh, cheese, white of egg, gluten of wheat, &c. They have also been detected in fresh blood, and occur very generally in glandular tissue and secretion—leucine, however, in much the larger proportion, so that in some cases where it has been recognised, the tyrosine probably accompanying it has been overlooked. Leucine, more particularly, has been found in the spleen, thymus, thyroid, and lymphatic glands; and, indeed, from its occurrence in the two former, received at one time the names of lienine and thymine.

Both leucine and tyrosine are met with most abundantly in the pancreas and its secretion, but they also occur in the liver and bile, and in the kidneys and urine, particularly in certain pathological conditions. Leucine has also been recognised in the salivary and intestinal glands and their secretions, and is, according to Bœdeker, an ordinary constituent of pus.

That leucine and tyrosine pre-exist in the living body, and are not merely post-mortem products, is evident from the circumstance of their having been detected in the urinary, pancreatic, and, in the case of leucine, purulent and salivary secretions of living animals. But more than this. A long time back, De la Rue noticed that tyrosine existed pre-formed in the dried cochineal insect, and Staedeler has more recently recognised the presence of both tyrosine and leucine in invertebrata belonging to all the principal non-infusorial classes, by crushing up the living animals in a mortar with a mixture of powdered glass and alcohol. Thus it is manifest that leucine and tyrosine are possessed of a very extensive natural distribution. But they have not as yet been detected in the juice of flesh, a circumstance, however, which appears the less surprising when we remember that even urea itself, an undoubted product of muscular metamorphosis, has never been satisfactorily recognised in healthy muscular tissue, probably on account of its rapid removal by the circulation.

Artificially, leucine and tyrosine may be produced from flesh, blood-albumen, white of egg, gluten, casein or cheese, gelatin, chondrin, elastic tissue, horn, nails, feathers, hair, hedgehog-spines, cockchafer-elytra, &c., &c., by one or other of two well-known indirect processes of oxidation, which consist in boiling the above-named substances for many hours with some mineral acid, or in fusing them gently with caustic alkali. Now, these two apparently opposite processes are the same in principle. In each case, the acid or alkali merely enables the protein or gelatinoid substance to react with water H_2O, whereby one portion of it becomes oxidised into leucine, tyrosine, &c., while another portion is hydrogenised into divers products. The nature of this action is best exposed by considering the case of some tolerably simple well-characterised substance—such, for instance, as benz-aldehyd, or essential oil of bitter almonds. When this body is treated with caustic potash, one-half of it becomes oxidised into benzoic acid, which appears in the form of an alkaline benzoate, and the other half is hydrogenised into benzyl-alcohol, as I mentioned a few minutes ago:—

$$\overset{\text{Benz-aldehyd.}}{2C_7H_6O} + \overset{\text{Water.}}{H_2O} = \overset{\text{Benzoic acid.}}{C_7H_6O_2} + \overset{\text{Benzyl-alcohol.}}{C_7H_8O}$$

When, however, a large excess of alkali is used, and the action allowed to become more violent, the hydrogen does not enter into any combination, but is simply liberated in the gaseous state, thus:—

$$\overset{\text{Benz-aldehyd.}}{C_7H_6O} + \overset{\text{Water.}}{H_2O} = \overset{\text{Benzoic acid.}}{C_7H_6O_2} + \overset{\text{Hydrogen.}}{H_2}.$$

Now, in fusing the above-mentioned animal substances with caustic alkali, a greater or less proportion of gaseous hydrogen from the decomposed tissue-water is similarly liberated; whereas, in boiling them with mineral acids, this same hydrogen, instead of being liberated, effects certain hitherto unexamined combinations or reactions; while, in both cases, the oxygen of the decomposed water effects the production of leucine and tyrosine. Here are specimens of leucine and tyrosine obtained in this way by the action of sulphuric acid on feathers, and here a fine specimen of tyrosine extracted from cochineal, all kindly lent me by Dr. Hugo Müller.

Thus the conclusion that nitrogenous tissue contains a something related to the fatty group and a something related to the aromatic group, suggested by the results of its direct oxidation with peroxide of manganese or chromic acid, is confirmed by the results of its indirect oxidation with acids and alkalies. Among fatty compounds, we obtain, in the one case, caproic acid, and, in the other, amido-caproic acid, or leucine; while among aromatic compounds we obtain, in the one case, benzoic acid, and, in the other, ethyl-amido-salicic acid, or tyrosine. Now, let us consider the constitution and respective relationships of these two bodies.

Starting from our primary fatty acids, we may obtain the following series of chlorine derivatives:—

Fatty acids.		α-Derivatives.	
CH_2O_2	Formic.	$CHClO_2$	Chloro-formic.
$C_2H_4O_2$	Acetic.	$C_2H_3ClO_2$	Chlor-acetic.
$C_3H_6O_2$	Propionic.	$C_3H_5ClO_2$	Chloro-propionic.
$C_4H_8O_2$	Butyric.	$C_4H_7ClO_2$	Chloro-butyric.
$C_5H_{10}O_2$	Valeric.	$C_5H_9ClO_2$	Chloro-valeric.
$C_6H_{12}O_2$	Caproic.	$C_6H_{11}ClO_2$	Chloro-caproic.

Now, if in each of these derived acids we replace the residue of hydrochloric acid, or Cl, by the residue of water, or HO, we obtain a new series of acids; whereas if we replace it by the residue of ammonia, H_2N, we obtain a series of amides, thus:—

β-Acids.		γ-Amides.	
$CH(HO)O_2$	Carbonic.	$CH(H_2N)O_2$	Carbamic?
$C_2H_3(HO)O_2$	Glycolic.	$C_2H_3(H_2N)O_2$	Glycocine.
$C_3H_5(HO)O_2$	Lactic.	$C_3H_5(H_2N)O_2$	Alanine.
$C_4H_7(HO)O_2$	Bulatic.	$C_4H_7(H_2N)O_2$	Bulatine.
$C_5H_9(HO)O_2$	Phocic.	$C_5H_9(H_2N)O_2$	Phocine.
$C_6H_{11}(HO)O_2$	Leucic.	$C_6H_{11}(H_2N)O_2$	Leucine.

Excluding the mono-carbon compounds, whose behaviour in other cases is frequently different from that of their more complex homologues, the β-acids and γ-amides may be obtained from the corresponding fatty acids through the intervention of their α-chloro-derivatives as above described. Excluding, again, the mono-carbon compounds, by acting upon any of the γ-amides with nitrous acids, we obtain the β-acids, whereas by acting on them with an electro-negative chloride and water, we obtain the α-chloro-acids, convertible into the normal acids by treatment with nascent hydrogen. Moreover, the γ-amides are producible and decomposible in a variety of other ways. The relation, therefore, of glycocine to the glycolic and chlor-acetic acids, and of leucine to the leucic and chloro-caproic acids, is merely the relation of ammonia $H.H_2N$, to water $H.HO$, and to chlorhydric acid $H.Cl$, as I explained to you more fully in my first lecture.

Glycocine I have referred to on several previous occasions. It is produced together with leucine and tyrosine by the action of acids or alkalies upon nitrogenous, and more particularly gelatigenous, tissues, whence its original name of sugar of gelatine. It exists as a constituent residue of sarcosine and kreatine, as well as of the hippuric and glycocholic acids. The next body, alanine, is obtainable from acet-aldehyd by treatment with aqueous prussic acid in the same way that leucine is obtainable from valer-aldehyd, as mentioned also in my first lecture. By analogy it should be called lactine, were not this appellation otherwise appropriated—namely, by milk sugar $C_6H_{12}O_6$, whose formula, you observe, is exactly twice that of lactic acid $C_3H_6O_3$, a compound to which milk sugar is in some way or other very closely related. It is curious that while lactic acid exists so largely in flesh-juice, gastric juice, &c., alanine should never have been recognised in any natural or artificial product of animal tissue. I am not aware that bulatine has yet been obtained from any source whatever; while phocine has been noticed upon one occasion only by Gorup-Besanez in the pancreas of an ox. Leucine, on the other hand, as I have already remarked, exists naturally in, and is producible artificially from, a great variety of animal and vegetable bodies.

In commencing the study of the constitution of tyrosine we are at once struck by the great resemblance which its formula bears to that of hippuric acid. You observe that the molecule of tyrosine differs in ultimate composition from the molecule of hippuric acid, by an excess of two atoms of hydrogen, thus:—

$C_9H_9NO_3$ Hippuric acid.
$C_9H_{11}NO_3$ Tyrosine.

Since, however, complex molecules of this description are built up of the residues of several simpler molecules, it may happen, and indeed not unfrequently does happen, that the number of the atoms of carbon, hydrogen, oxygen, and nitrogen in two or more complex bodies, approximate very closely to, or are even identical with, one another; whilst the bodies themselves are built up of very different residues, and accordingly have no real relationship of proximate constitution. Such, however, is not the case with hippuric acid and tyrosine. Each of these bodies is composed of three constituent residues—namely, an ammonia residue, a 2-carbon residue, belonging to the fatty, and a 7-carbon residue, belonging to the aromatic class. That the aromatic residue of tyrosine, however, differs from the hippuric acid residue, in belonging to the salicic instead of the benzoic sub group, is evident from a variety of considerations pointed out by Schmitt and Nasse, whose recently published views on the constitution of tyrosine, if not demonstrated with absolute certainty, are so probable in themselves, and so supported by collateral testimony, as to leave us in very little doubt as to their substantial correctness. Thus tyrosine agrees with other salicic compounds in the characteristic properties of yielding phenol by distillation, and chloranil by chlorination, and, after suitable treatment, of striking a purple colour with persalts of iron, as you perceive. This last reaction constitutes Piria's well-known test for tyrosine. Now, according to Schmitt and Nasse, the particular member of the salicic sub-group which enters into the constitution of tyrosine is salicic acid, whose formula, you observe, differs from that of benzoic acid by an excess of one atom of oxygen. Moreover, benzoic acid is isomeric with salicic aldehyd, and salicic acid with ampelic or oxi-benzoic acid, thus,—

$C_7H_6O_2$ Benzoic acid, and salicic aldehyd.
$C_7H_6O_3$ Ampelic acid, and salicic acid.

With regard to the natural history of salicic compounds, salicine, as I have already explained, is a glucoside of salicylic alcohol, and oil of spiræa constitutes salicic aldehyd, while oil of wintergreen is composed largely of methylic salicate, or salicic methyl-ether. Some salicic compound, moreover, occurs as a constituent residue of indigo C_8H_5NO, as shown by the following considerations. Thus, when indigo experiences decomposition by treatment with reagents, its single atom of nitrogen and one of its eight atoms of carbon are more particularly affected, and hence, as a convenient representation of its probable molecular constitution, we may associate this mobile carbon and nitrogen with one another, and so write the formula of indigo upon the 7-carbon or salicic type, thus—

$C_7H_5(CN)O$. Indigo or cyan-salicol.

Now, by boiling indigo for a long time with oxidising agents, and by treating salicic acid with strong nitric acid, we obtain identically the same product, which has received the names of anilic, indigotic, and nitro-salicic acid, thus—

$$\overset{\text{Indigo.}}{C_7H_5(CN)O} + \overset{\text{Oxygen.}}{O_6} = \overset{\text{Anilic acid.}}{C_7H_5(NO_2)O_3} + \overset{\text{Carb-anhyd.}}{CO_2}$$

$$\overset{\text{Salicic acid.}}{C_7H_6O_3} + \overset{\text{Nitric acid.}}{(NO_2)HO} = \overset{\text{Nitro-salicic acid.}}{C_7H_5(NO_2)O_3} + \overset{\text{Water.}}{H.HO}$$

Again, when indigo is gently fused with caustic alkali it undergoes a simultaneous hydration and oxidation, whereby it is converted into anthranilic acid, or amido-salicic aldehyd, thus—

$$\overset{\text{Indigo.}}{C_7H_5(CN)O} + \overset{\text{Water.}}{H_2O} + \overset{\text{Oxygen.}}{O_2} = \overset{\text{Anthranil. acid.}}{C_7H_5(H_2N)O_2} + \overset{\text{Carb-anhyd.}}{CO_2}$$

When, however, the reaction takes place more violently, we get normal salicic acid, produced, thus—

$$\overset{\text{Indigo.}}{C_7H_5(CN)O} + \overset{\text{Water.}}{2H_2O} + \overset{\text{Oxygen.}}{O_2} = \overset{\text{Salicic acid.}}{C_7H_5(HO)O_2} + \overset{\text{Ammonia.}}{H_3N} + \overset{\text{Carb-anhyd.}}{CO_2}$$

You observe that the anthranilic and salicic acids furnish us with another instance of that relationship between amidated and hydrated compounds to which I have so often adverted.

Seeing from the observations and researches of Prout, Heller, Debuyne, Hassall, Scheerer, Schunk, and others, that human urine not unfrequently deposits indigo spontaneously, and contains habitually an indigo-yielding substance known as indican, which is probably a glucoside of white or hydrogenised indigo, we come to the conclusion that while a salicic residue in the form of tyrosine is a constant product of the natural and artificial oxidation of nitrogenous tissue, another salicic residue in the form of indigo or indican is a usual ingredient of that secretion by which the products of disintegrated nitrogenous tissue are principally discharged. Moreover, this occurrence of indigo in urine further exemplifies a point with which we must all, I believe, have been more or less struck, both in this and previous lectures—namely, the thorough interdependence of vegetable and animal chemistry, as shown by the frequent relationship and even identity of products formed in vegetable and animal organisms.

Another physiological point of interest connected with salicic compounds is their occurrence in the urine in the form of salisuric acid. It is well known that when benzoic aldehyd or acid is taken internally, it makes its appearance in the urine in the form of glyco-benzoic or hippuric acid $C_9H_9NO_3$; and, no doubt, some, at any rate, of the hippuric acid excreted both by vegetable and mixed feeders is derived from the ingestion of certain benzo-genetic articles of food. Similarly, the administration of salicine and salicic aldehyd or acid is followed by the appearance in the urine of glyco-salicic or salisuric acid $C_9H_9NO_4$, readily decomposible into glycocine and salicic acid, just as hippuric acid is decomposible into glycocine and benzoic acid. Hence the salisuric and salicic acids may be regarded as normal constituents of the urine of the beaver and possibly other rodents, with whom willow bark is a favourite food. The occurrence of salicic compounds in castoreum also is doubtless due in a similar manner to the food of the beaver. Castoreum, moreover, contains phenol, or coal-tar creosote, which, according to Staedeler and others, is an ordinary constituent of human urine, and an important contributor to its characteristic odour. Now, the relation of phenol to salicic acid is very simple. Under suitable conditions salicic acid breaks up into phenol and carb-anhydride, which, under other conditions, re-unite to form salicic acid, thus—

$$\overset{\text{Phenol.}}{C_6H_6O} + \overset{\text{Carb-anhyd.}}{CO_2} = \overset{\text{Salicic acid.}}{C_7H_6O_3}.$$

Remembering that urine of a dark brown colour, or becoming of a brown colour by oxidation, contains a pigment which is in some way or other related to indigo, and also that an apparently similar brown urine is occasionally passed after the internal or external administration of phenol, kreasote, tar-oil, &c., this relationship of salicic and phenyl compounds presents a considerable pathological interest. Phenol may indeed be considered as the nucleus not only of salicic acid, but likewise of tyrosine and indigo, from both of which also it is readily obtainable. Moreover, by treatment with chlorine, all four bodies yield the same 6-carbon ultimate product, namely, chloranil $C_6Cl_4O_2$, or perchloroquinone.

It now only remains for us to consider the ultimate constitution of tyrosine, and its analogy to hippuric acid. Starting from water and ammonia, we have the following alcoholic derivatives :—

Hydrates.		Amines.	
$\left.\begin{matrix}H\\H\end{matrix}\right\}O$	Hydric	$\left.\begin{matrix}H\\H.H\end{matrix}\right\}N$	Hydr-amine
$\left.\begin{matrix}H\\CH_3\end{matrix}\right\}O$	Methylic	$\left.\begin{matrix}H\\CH_3.H\end{matrix}\right\}N$	Methyl-amine
$\left.\begin{matrix}H\\C_2H_5\end{matrix}\right\}O$	Ethylic	$\left.\begin{matrix}H\\C_2H_5.H\end{matrix}\right\}N$	Ethyl-amine

Now, replacing an atom of hydrogen, or the atom of chlorine, in acetic and chloracetic acid respectively, by the residue of water HO, we obtain glycolic or oxiacetic acid; replacing it by the residue of ammonia H_2N, we obtain amid-acetic acid, or glycocine; replacing it by the residue of methylamine CH_4N, we obtain methyl-amid-acetic acid, or methyl-glycocine, or sarcosine; and, lastly, replacing it by the residue of ethylamine C_2H_6N, we obtain ethyl-amid-acetic acid, or ethyl-glycocine, thus :—

Acetic Derivatives.	
$C_2H_4O_2$	Acetic acid.
$C_2H_3(Cl)O_2$	Chlor-acetic acid.
$C_2H_3(HO)O_2$	Glycolic acid.
$C_2H_3(H_2N)O_2$	Glycocine.
$C_2H_3(CH_3HN)O_2$	Sarcosine or methyl-glycocine.
$C_2H_3(C_2H_5HN)O_2$	Ethyl-glycocine.

The constitution and mutual relationship of the above tabulated bodies have been established as well by their recomposition as by their decomposition. In the case of tyrosine, however, we have only a knowledge of its decompositions to fall back upon, from which, however, it would appear, according to Schmitt and Nasse, that in its constitution tyrosine corresponds most nearly with sarcosine or methyl-glycocine among natural products, and still more nearly with the artificial ethyl-glycocine of Heintz. Just, indeed, as sarcosine is acetic acid in which an atom of hydrogen is replaced by the residue of methylamine, so is tyrosine salicic acid in which an atom of hydrogen is replaced by the residue of ethylamine, thus :—

$C_2H_3(CH_3.HN)O_2$ Sarcosine.
$C_7H_5(C_2H_5.HN)O_3$ Tyrosine.

Lastly, Dessaignes having prepared hippuric acid by substituting a residue of glycocine for the atom of chlorine in chlorobenzoic aldehyd $C_7H_5(Cl)O$, the relationship of hippuric acid and tyrosine to one another and to the benzoic and salicic acids is shown by the following formulæ, the parentheses of which are merely intended to point out the exchanged portions of the original and derived bodies:—

Benzoic acid.	Hippuric acid.
$C_7H_5(HO)O$	$C_7H_5(C_2H_2O_2.HN)O$
Salicic acid.	Tyrosine.
$C_7H_5(H)O_3$	$C_7H_5(C_2H_5.HN)O_3$

Now, alcohol is directly convertible into glycolic acid, and hence ethylamine indirectly convertible into glycocine, by oxidation, whereas salicic acid is convertible into benzoic acid by hydrogenation; so that the fatty 2-carbon constituent of hippuric acid is more highly oxidised than that of tyrosine, while the aromatic 7-carbon constituent of tyrosine is more highly oxidised than that of hippuric acid. Doubtless, therefore, the natural production of the two bodies by tissue metamorphosis takes place under different conditions. Their joint occurrence in the urine, however, together with that of indigo and phenol, confirms the inference we have already drawn—that be the chemical constitution of nitrogenous tissue what it may, there exist in its molecule one or more groupings belonging to the fatty family, and yielding fatty oxidation-products, together with one or more groupings belonging to the aromatic family, and yielding fatty oxidation-products. In my next lecture we shall consider the intimate constitution of uric acid and its congeners.

BRITISH ASSOCIATION.

Birmingham Meeting, President, Professor Phillips, *M.A., &c., &c.*

President's Address, delivered September 6.

(*Continued from page 119.*)

The greater our progress in the study of the economy of nature, the more she unveils herself as one vast whole; one comprehensive plan; one universal rule, in a yet unexhausted series of individual peculiarities. Such is the aspect of this moving, working, living system of force and law, such it has ever been, if we rightly interpret the history of our own portion of this rich inheritance of mind, the history of that earth from which we spring, with which so many of our thoughts are co-ordinated, and to which all but our thoughts and hopes will again return.

How should we prize this history! and exult in the thought that in our own days, within our own memories, the very foundations of the series of strata, deposited in the beginning of time, have been explored by our living friends, our Murchison and Sedgwick, while the higher and more complicated parts of the structure have been minutely examined by our Lyell, Forbes, and Prestwich![*] How instructive the history of that long series of inhabitants which received in primeval times the gift of life, and filled the land, sea, and air with rejoicing myriads, through innumerable revolutions of the planet, before in the fulness of time it pleased the Giver of all good to place man upon the earth, and bid him look up to Heaven.

Wave succeeding wave, the forms of ancient life sweep across the ever-changing surface of the earth; revealing to us the height of the land, the depth of the sea, the quality of the air, the course of the rivers, the extent of the forest, the system of life and death—yes, the growth, decay, and death of individuals, the beginning and ending of races, of many successive races of plants and animals, in seas now dried, on sand-banks now raised into mountains, on continents now sunk beneath the waters.

Had that series a beginning? Was the earth ever uninhabited, after it became a globe turning on its axis and revolving round the sun? Was there ever a period since land and sea were separated—a period which we can trace—when the land was not shaded by plants, the ocean not alive with animals? The answer, as it comes to us from the latest observation, declares that in the lowest deposits of the most ancient seas in the stratified crust of the globe, the monuments of life remain. They extend to the earliest sediments of water, now in part so changed as to appear like the products of fire. What life? Only the simpler and less specially organised fabrics have as yet rewarded research among these old Laurentian rocks—only the aggregated structures of Foraminifera have been found in what, for the present at least, must be accepted as the first deposits of the oldest sea. The most ancient of all known fossils, the Eozoon Canadense of Sir W. Logan, is of this low, we may even say lowest, type of animal organisation.

Then step by step we are guided through the old Cambrian and Silurian systems, rich in Trilobites and Brachiopoda, the delights of Salter and Davidson; with Agassiz, and Miller, and Egerton we read the history of the strange old fishes of the Devonian rocks; Brongniart, and Göppert, and Dawson, and Binney, and Hooker unveil the mystery of the mighty forests now converted to coal; Mantell, and Owen, and Huxley restore for us the giant reptiles of the Lias, the Oolite, and the Wealdon; Edwards and Wright almost revive the beauteous corals and echinodermata; which with all the preceding tribes have come and gone before the dawn of the later periods, when fragments of mammoths and hippopotami were buried in caves and river sediments to reward the researches of Cuvier and Buckland, Prestwich and Christy, Lartet and Falconer.

And what is the latest term in this long series of successive existence? Surely the monuments of ever-advancing art—the temples whose origin is in caverns of the rocks; the cities which have taken the place of holes in the ground, or heaps of stones and timber in a lake; the ships which have outgrown the canoe, as that was modelled from the floating trunk of a tree, are sufficient proof of the late arrival of man upon the earth, after it had undergone many changes and had become adapted to his physical, intellectual, and moral nature.

Compared with the periods which elapsed in the accomplishment of these changes, how short is the date of those yet standing monoliths, cromlechs, and circles of unhewn stone which are the oldest of human structures raised in Western Europe, or of those more regular fabrics which attest the early importance of the monarchs and people of Egypt, Assyria, and some parts of America! Yet tried by monuments of natural events which happened within the age of man, the human family is old enough in Western Europe to have been sheltered by caverns in the rocks, while herds of reindeer roamed in Southern France,[†] and bears and hyænas were denizens of the South of England.[‡] More than this, remains of the rudest human art ever seen are certainly found buried with and are thought to belong to races who lived contemporaneously with the mammoth and rhinoceros, and experienced the cold of a Gallic or British winter, from which the woolly covering of the wild animals was a fitting protection.

Our own annals begin with the Kelts, if indeed we are entitled to call by that historic name the really separate nations, Belgian, Iberian, and Teutonic, whom the Roman writers recognise as settlers in Britain;[§] settlers among a really earlier family, our rudest and oldest forefathers,

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[*] The investigations of Murchison and Sedgwick in the Cambrian and Silurian strata began in 1831; the views of Sir C. Lyell on Tertiary periods were made known in 1829.

[†] See the memoirs of M. Lartet on the "Caves of the Dordogne," 1863-4.

[‡] In the caves of Gower, Devon, and Somerset, flint flakes occur with several extinct animals.

[§] Gallic or Belgian on the south-east coast; Iberian in South Wales; German at the foot of the Grampians.—(Tacitus, Vita Agricolæ.)

who may have been, as they thought themselves to be, the primitive people of the land.[‖] But beyond the Κελταί who occupied the sources of the Danube and the slopes of the Pyrenees, and were known to Rome in later days, there was present to the mind of the father of Grecian history a still more western race, the Cynetæ, who may perhaps be supposed the very earliest people of the extreme west of the continent of Europe. Were those the people, the first poor pilgrims from the East, whose footsteps we are slowly tracing in the valleys of Picardy and the south of England, if not on the borders of the lakes of Switzerland? Are their kindred still to be found among the Rhætic Alps and the Asturian cliffs, if not amid the wilds of Connemara, pressed into those mountainous recesses by the legions of Rome, the spear of the Visigoth, and the sword of the Saxon? Or must we regard them as races of an earlier type, who had ceased to chip flints before the arrival of Saxon, or Goth, or Kelt, or Cynetian? These questions of romantic interest in the study of the distribution and languages of the families of man are part of a large circle of inquiry which finds sympathy in several of our sections, especially those devoted to Zoology, Physiology, and Ethnology. Let us not expect or desire for them a very quick, or, at present, a very definite settlement. Deep shadows have gathered over all the earlier ages of mankind, which perhaps still longer periods of time may not avail to remove. Yet let us not undervalue the progress of ethnological inquiry, nor fail to mark how, within the period to which our recollections cling, the revelations of early Egypt have been followed by a chronology of the ancient kingdoms on the Tigris and Euphrates, through the same rigorous study of language. Thus has our Rawlinson added another page to the brilliant discoveries of Young and Champollion, Lepsius and Rosellini.

Nor, though obtained in a different way, must we forget the new knowledge of a people nearer home, which the philosophic mind of Keller has opened to us among his native mountains. There, on the borders of the Alpine lakes, before the great Roman general crossed the Rhone, lived a people older than the Helvetians; whose rude lives, passed in hunting and fishing, were nevertheless marked by some of the many inventions which everywhere, even in the most unfavourable situations, accompany the least civilised of mankind. Implements of stone and pottery of the rudest sort belong to the earliest of these people; while ornamented iron weapons of war, and innumerable other fabrics in that metal, appear about the later habitations, and correspond probably to the period of the true Helvetii, who quitted their home and contended with Cæsar for richer settlements in Gaul. The people of whom these are the traces on almost every lake in Switzerland are recognised as well in the ancient lake-basins of Lombardy and among the Tyrolean Alps, and farther on the north side of the mountains; and probably fresh discoveries may connect them with the country of the Sarmatians and the Scythians.

Thus at length is fairly opened, for archæology and palæontology to read, a new chapter of the world's history, which begins in the pleistocene periods of geology, and reaches to the prehistoric ages of man. Did our ancestors really contend, as the poets fancied,[¶] with stones and clubs against the lion and the rhinocerous, and thus expel them from their native haunts, or have they been removed by change of climate or local physical conditions? Was the existence of the hyæna and the elephant only possible in Western Europe while a climate prevailed there such as now belongs to Africa or India? and was this period of high temperature reduced in a later time for the elk, reindeer, and musk ox, which undoubtedly roamed over the hills of England and France? If we think so, what a vista of long duration stretches before us, for no such changes of climate can be supposed to have occurred except as the effect of great physical changes, requiring a lapse of many thousands of years. And though we may think such changes of climate not proved, and probably careful weighing of evidence may justify our disbelief, still, if the valleys in Picardy have been excavated since the deposit of the gravel of St. Acheul,[**] and the whole face of the country has been altered about the caverns of Torquay since they received remains of animals and traces of man[††]—how can we admit these facts and yet refuse the time required for their accomplishment? First, let us be sure of the facts, and especially of that main fact upon which all the argument involving immensity of time really turns, viz., the contemporaneous existence of man with the mammoth of the plains and the bear of the caverns. The remains of men are certainly *buried* with those of extinct quadrupeds; but did they *live* in the some days, or do we see relics of different periods gathered into one locality by natural processes of a later date, or confused by the operations of men?

Before replying finally to these questions, further researches of an exact kind are desirable, and the Association has given its aid towards them, both in respect to the old cavern of Kent's Hole, and the newly-opened fissure of Gibraltar, from which we expect great results, though the best of our labourers has ceased from his honourable toil.[‡‡] When these and many other researches are completed, some future Lyell, if not our own great geologist, may add some fresh chapters to the "Antiquity of Man."

In judging of this antiquity, in counting the centuries which may have elapsed since smoothed flints fitted with handles of wood were used as chisels and axes by the earliest people of Scandinavia or Helvetia, and flakes of flint were employed to cleanse the skins of the reindeer in the caves of the Dordogne, or stronger tools broke up the ice in the valley of the Somme, we must be careful not to take what is the mark of low civilisation for the indication of very remote time. In every country, among every race of men, such rude weapons are used now, or were used formerly. On the banks of the Ohio, no less than on the English hills, mounds of earth, rude pottery, and stone weapons occur in abundance; and indicate similar wants, contrivances, customs, ideas, in different races of men living in different periods. Even when in the same country, as in Switzerland, or England, or Denmark, successive deposits of instruments of stone, bronze, or iron; successive burials of pines, beeches, and oaks; successively extinguished races of elephants, elks, and reindeer, give us a real scale of elapsed time, it is one of which the divisions are not yet valued in years or centuries of years.

Toward a right judgment of the length of this scale of human occupation, two other lines of evidence may be thought worthy of notice; one founded on the anatomical study of the remains of early men, the other on the laws of language. If the varieties of physical structure in man, and the deviations of language from an original type, be natural effects of time and circumstance, the length of time may be in some degree estimated by the amount of the diversities which are observed to have happened, compared with the variation which is now known to be happening. This process becomes imaginary, unless we assume all mankind to have had one local centre, and one original language. Its results must be erroneous, unless we take fully into account the superior fixity of languages which are represented in writing, and the greater tendency to diversity of every kind which must have prevailed in early

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[‖] "Britannicæ pars interior ab iis incolitur, quos natos in insula ipsa memoria proditum dicunt."—(Cæsar, v. 12.)

[¶] Lucretius, v. 964—1288.

[**] Prestwich, Transactions of the Royal Society, 1860, and Proc. of Roy. Inst., Feb. 1864.

[††] Pengelly, Reports of the British Association, 1864.

[‡‡] The late Dr. Hugh Falconer, whose knowledge of the fossil animals of caves was remarkably exact, took a great share in these examinations.

times, when geographical impediments were aggravated by dissocial habits of life. It appears, however, certain that some differences of language, organisation, and habits have separated men of apparently unlike races during periods longer than those which rest on historical facts.§§

Ever since the days of Aristotle, the analogy existing among all parts of the animal kingdom, and in a general sense we may say among all the forms of life, has become more and more the subject of special study. Related as all living beings are to the element in which they move and breathe, to the mechanical energies of nature which they employ or resist, and to the molecular forces which penetrate and transform them, some general conformity of structure, some frequently recurring resemblance of function, must be present, and cannot be overlooked. In the several classes this analogy grows stronger, and in the subdivisions of these classes real family affinity is recognised. In the smallest divisions which have this family relation in the highest degree, there seems to be a line which circumscribes each group, within which variations occur, from food, exercise, climate, and transmitted peculiarities. Often one specific group approaches another, or several others, and a question arises whether, though now distinct, or rather distinguishable, they always have been so from their beginning, or will be always so until their disappearance.

Whether what we call species are so many original creations or derivations from a few types or one type, is discussed at length in the elegant treatise of Darwin||||, himself a naturalist of eminent rank. It had been often discussed before. Nor will any one think lightly of such inquiries, who remembers the essay of Linnæus, "De Telluris orbis incremento," or the investigations of Brown, Prichard, Forbes, Agassiz, and Hooker regarding the local origin of different species, genera, and families of plants and animals, both on the land and in the sea. Still less will he be disposed to undervalue its importance, when he reflects on the many successive races of living forms more or less resembling our existing quadrupeds, reptiles, fishes, and mollusca, which appear to have occupied definite and different parts of the depths of ancient time; as now the tiger and the jaguar, the cayman and the gavial, live on different parts of the terrestrial surface. Is the living elephant of Ceylon the lineal descendant of that mammoth which roamed over Siberia and Europe, and North America, or of one of those sub-Himalayan tribes which Dr. Falconer has made known, or was it a species dwelling only in circumpolar regions? Can our domestic cattle, horses, and dogs, our beasts of chase and our beasts of prey, be traced back to their source in older types, contemporaries of the urus, megaceros, and hyæna on the plains of Europe? If so, what range of variation in structure does it indicate? if not so, by what characters are the living races separated from those of earlier date?

Specific questions of this kind must be answered before the general proposition, that the forms of life are indefinitely variable with time and circumstance, can be even examined by the light of adequate evidence. That such evidence will be gathered and rightly interpreted, I for one neither doubt nor fear; nor will any be too hasty in adopting extreme opinions or too fearful of the final result, who remember how often that which is true has been found very different from that which was plausible, and how often out of the nettles of danger we have plucked the flowers of safety. At the present moment the three propositions which were ever present to the mind of Edward Forbes may be successfully maintained, as agreeing with many observed phenomena; and around them as a basis of classification may be gathered most of the facts and most of the speculations which relate to the history of life.¶¶ First, it may be admitted that plants and animals form many natural groups, the members of which have several common characters, and are parted from other groups by a real boundary line, or rather unoccupied space. Next, that each of these groups has a limited distribution in space, often restrained by high mountains or deep seas, or parallels of temperature, within which it has been brought into being. Thirdly, that each group has been submitted to, or is now undergoing the pressure of a general law, by which its duration is limited in geological time; the same group never reappearing after being removed from the series.

How important, in the view of this and many other questions, is that never-tiring spirit of geographical and maritime discovery, to which through 400 years Europe has sent her noblest sons and her most famous expeditions; sent them, alas! too often to an early grave. Alas! for Franklin, who carried the magnetic flag into the Icy Sea from which he had already brought trophies to science! Alas! for Speke, who came home with honour from the head waters of the Nile! Forgotten they can never be, whenever on occasions like this we mourn the absence of our bravest and our best; praise, never-ending praise be theirs, while men retain the generous impulse which prompts them to enterprises worthy of their country and beneficial to mankind!

'Αεὶ σφῶν κλέος ἔσσεται κατ' αἶαν.

If it be asked what share in the discoveries and inventions of the last thirty-three years is claimed for the British Association, let us answer fearlessly—We had a part in all. In some of them we took the foremost place by the frequency of our discussions, the urgency of our recommendations, the employment of our influence, and the grant of our funds. For others we gave all our strength, to support the Royal Society and other Institutions in their efforts to accomplish purposes which we approve. In all instances our elastic system responds quickly to pressure, and returns the friendly impulse. If we look back on the work of previous years, it is easy to mark the special action of the Association in fields which hardly could be entered by any other adventurers.

Many of the most valuable labours of which we are now reaping the fruits, were undertaken in consequence of the reports on special branches of science which appear in the early volumes of our *Transactions*—reports in which particular data were requested for confirming or correcting known generalisations, or for establishing new ones. Thus a passage in Professor Airy's report on Physical Astronomy* first turned the attention of Adams to the mathematical vision of Neptune; Lubbock's Report on Tides† came before the experimental researches and reductions which since 1834 have so often engaged the attention of Whewell and Airy and Haughton, with results so valuable and so suggestive of further undertakings. Among these results may be placed additional knowledge of the probable depth of the channels of the sea. For before the desire of telegraphic communication with America had caused the bed of the North Atlantic to be explored by soundings to a depth seldom exceeding three miles, there was reason to conclude from the investigations of Whewell on Cotidal Lines‡ that a depth of nine miles was attained in the South Atlantic, and from the separate computations of Airy and Haughton that a somewhat greater depth occurred in a part of the course of the tide wave which washes the coast of Ireland.§ The greater portion of the sea-bed is within reach of soundings

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§§ Max Muller on the Science of Language.

|||| On the Origin of Species, 1859.

¶¶ See the remarkable essay of E. Forbes on the distribution of the existing Fauna and Flora of the British Isles, in "Memoirs of Geol. Survey of Britain," vol. i., p. 336.

* Reports of the British Association for 1832, p. 154. Laplace had indeed observed that "the planet Uranus and his satellites, lately discovered, give reason to suspect the existence of some planets not yet observed;" thereby encouraging the search for new discoveries in our own system. ("Exp. du Syst. du Monde") 1799, 4to. p. 350.)

† Reports of the British Association, 1832.

‡ *Trans.* of Roy. Soc., 1833.

§ *Trans.* of Roy. Irish Acad., 1855.

directed by the superior skill and greater perseverance of modern scientific navigators; a depth of six miles is said to have been reached in one small tract of the North Atlantic; depths of nine or ten miles in the deepest channels of the sea are probable from considering the general proportion which is likely to obtain between sea-depths and mountain-tops. Thus the data are gradually being collected for a complete survey of the bed of the sea, including among other things information, at least, concerning the distribution of animal and vegetable life beneath the waters.

Waves—their origin, the mechanism of their motion, their velocity, their elevation, the resistance they offer to vessels of given form, these subjects have been firmly kept in view by the Association, since first Professor Challis[||] reported on the mathematical problems they suggest, and Sir J. Robinson and Mr. Scott Russell undertook to study them experimentally.[¶] Out of this inquiry has come a better knowledge of the forms which ought to be given to the "lines" of ships, followed by swifter passages across the sea, both by sailing vessels and steamers, of larger size and greater lengths than were ever tried before.[**]

One of the earliest subjects to acquire importance in our thoughts was the unexplored region of meteorology laid open in Professor J. Forbes' Reports.[††] Several of the points to which he called attention have been successfully attained. The admirable instruments of Whewell, Osler, and Robinson have replaced the older and ruder anemometers, and are everywhere in full operation, to record the momentary variations of pressure, or sum the varying velocities of the wind. No small thanks were due to Mr. Marshall and Mr. Miller[‡‡] for their enterprise and perseverance in placing rain gauges and thermometers amidst the peaks of Cumberland and Westmoreland. These experiments are now renewed in both counties and in North Wales; and I hope to hear of similar efforts among the mountains of the West of Ireland and the West of Scotland. Our meteorological instruments of every kind have been improved; our system of photographic registration has spread from Kew into other observatories; and our corresponding member, Professor Dovè, has collected into systematic maps and tables the lines and figures, which represent annual and monthly climate over every land and sea.

In the same manner, by no sudden impulse or accidental circumstance, rose to its high importance that great system of magnetic observations, on which for more than a quarter of a century the British Association and the Royal Society, acting in concert, have been intent. First, we had reports on the mathematical theory and experimental researches of magnetism by Christie, 1833, Whewell, 1835, and Sabine, 1835; afterwards, a magnetic survey of the British islands;[§§] then the establishment of a complete observatory at Dublin, with newly-arranged instruments, by Dr. Lloyd, in 1838. On all this gathered experience we founded a memorial to Her Majesty's Government, made a grant of 400*l.* from our funds for preliminary expenses, and presented to the meeting of this Association in Birmingham in 1839 a report of progress, signed by Herschel and Lloyd. From that time how great the labour, how inestimable the fruits! Ross sails to the magnetic pole of the South; America and Russia co-operate with our observers at Kew, Toronto, and St. Helena; and General Sabine, by combining all this united labour, has the happiness of seeing results established of which no man dreamed—laws of harmonious variation affecting the magnetic elements of the globe, in definite relation to the earth's movement, the position of the sun and moon, the distribution of temperature, and the situation in latitude and longitude.[||||]

Our efforts have not been fruitless, whether with Mr. Mallet we make experiments on artificial earthshocks at Dalkey, or survey the devastations round Vesuvius, or tabulate the records of earthquakes since the beginning of history[¶¶]; or establish the Kew Observatory as a scientific workshop where new instruments of research are made and proved and set to work[*]; or dredge the sea with Forbes, and Brady, and Jeffreys[†]; or catalogue the stars with Baily[‡]; or investigate electricity with Harris, Ronalds, Thomson, and Jenkin[§]; or try the action of long-continued heat with Harcourt[||]: in these and a hundred other directions our attempts to gain knowledge have brought back new facts and new laws of phenomena, or better instruments for attaining or better methods for interpreting them. Even when we enter the domain of practical art, and apply scientific methods to test a great process of manufacture, we do not fail of success; because we are able to join in united exertion the laborious cultivators of science and the scientific employers of labour.

Am I asked to give an example? Let it be iron, the one substance by the possession of which, by the true knowledge and right use of which, more than by any other thing, our national greatness is supported. What are the ores of iron—what the peculiarities and improvements of the smelting processes—what the quality of the iron—its chemical composition—its strength in columns and girders as cast-iron; in rails and boiler plate, in tubes and chains, as wrought iron—what are the best forms in which to employ it, the best methods of preserving it from decay;—these and many other questions are answered by many special reports in our volumes, bearing the names of Barlow, Mallet, Porter, Fairbairn, Bunsen, Playfair, Percy, Budd, Hodgkinson, Thomson; and very numerous other communications from Lucas, Fairbairn, Cooper, Nicholson, Price, Crane, Hartley, Davy, Mushet, Hawkes, Penny, Scoresby, Dawes, Calvert, Clark, Cox, Hodgkinson, May, Schafhaeutl, Johnston, Clay, and Boutigny. Beyond a question, a reader of such of these valuable documents as relate to the strength of iron, in its various forms, would be far better informed of the right course to be followed in experiments on armour-plated ships and forts to resist assault, and in the construction of ordnance to attack them, than he is likely to be from merely witnessing a thousand trials of the cannon against the target. Any one who remembers what the iron furnace was forty years ago, and knows its present power of work, or who contrasts the rolling mills and hammers of other days with the beautiful machines which now, with the gentlest motion, but irresistible force, compel the strong metal to take up the most delicately moulded form, will acknowledge that within the period since the British Association began to set itself to the task of reconciling the separated powers of theory and experience there has been a total change in the aspect of each, to the great advantage of both.

[||] Reports of the British Association, 1833, 1836.

[¶] *Ibid* 1837 and following years.

[**] *Ibid.*, 1840—1841.

[††] Reports of the British Association, 1832—1840.

[‡‡] Mr Marshall's Observations were made in Patterdale, Mr. Miller's about Wastdale Head. (British Association Reports for 1846, and Royal Society's Transactions, 1850.)

[§§] The survey was begun in Ireland in 1835, by Lloyd, Sabine, and Ross; and completed in England, Wales, and Scotland in 1837, by the same magneticians, assisted by Fox and Phillips. It was repeated in 1857 and following years by Sabine, Lloyd, Welsh, Haughton, Galbraith, and Stoney.

[||||] Trans. of the Royal Society for many years; Reports of the British Association, 1840 and following years; Rede Lecture, 1862.

[¶¶] British Association Reports; Experiments at Dalkey, 1853; Report on Earthquakes, 1840-1858. See also the excellent communications of M. Perrey to the Memoirs of the Academy of Dijon.

[*] The Kew Observatory became a part of the system of the Association in 1842.

[†] See Reports of the Dredging Committees from 1842 to 1864; Nat. Hist. Trans. of Northumberland and Durham; Jeffreys' British Conchology.

[‡] British Association Catalogue of Stars, 1845.

[§] The latest result of these researches is an instrumental standard of electrical resistance. (Reports of the British Association, 1863-1864.)

[||] Reports of the British Association, 1846-1860.

Our undertakings have not been fruitless. We attempted what we had well considered, and had the power to accomplish; and we had the more than willing help of competent persons of our own body, the friendly aid of other Institutions, and the sanction of the Government, convinced of the sincerity of our purpose and the wisdom of our recommendations.

The same work is ever before us; the same prudence is always necessary; the same aid is always ready. Great, indeed, should be our happiness in reflecting on the many occasions when the Royal Society in particular, and other Institutions older than our own, have readily placed themselves by our side, to share our responsibility and diminish our difficulties. But for this, our wishes might not always have prevailed; and the horizon of science would not have been so clear as now it is. Of late years, indeed, societies formed on our model have taken up special parts of our work; and thus to some extent have relieved us of the pressure of communications relating to the practice of particular professions and the progress of some public questions. Not that scientific agriculture, social statistics, or physiology are neglected in our meetings, but that these and other practical subjects are found to have more than one aspect, and to require more than one mode of treatment. With us, facts well ascertained, conclusions rightly drawn, will ever be welcome, from whatever quarter of the horizon of science they make their appearance. Whatever societies cultivate these objects, they are our allies, and we will help them, if we may. With pleasure we receive proofs of the good work done in limited districts by the many admirable field clubs formed by our countrymen; whether, like those of Tyne-side and the Cotswolds, and in this immediate vicinity those of Warwickshire, Worcestershire, and Dudley, they explore the minutest recesses of our hills and glens; or, like the rangers of the Alps, bring us new facts regarding glaciers, ancient climate, and altered levels of land and sea.

By these agreeable gatherings natural history is most favourably commended; and in the activity and enlarged views of the officers who conduct them, the British Association recognises the qualities, by which the vitality of scientific research is maintained, and its benefits diffused among the provincial institutions of the Empire.

Such, Gentlemen, are some of the thoughts which fill the minds of those who, like our Brewster, and Harcourt, and Forbes, and Murchison, and Daubeny, stood, anxious but hopeful, by the cradle of this British Association; and who now meet to judge of its strength and measure its progress. When, more than thirty years ago, this Parliament of Science came into being, its first child-language was employed to ask questions of Nature; now, in riper years, it founds on the answers received further and more definite inquiries directed to the same prolific source of useful knowledge. Of researches in science completed, in progress, or in beginning, each of our annual volumes contains some three hundred or more passing notices, or full and permanent records. This digest and monument of our labours is indeed in some respects incomplete, since it does not always contain the narrative or the result of undertakings which we started, or fostered, or sustained; and I own to having experienced on this account once or twice a feeling of regret. But the regret was soon lost in the gratification of knowing that other and equally beneficial channels of publication had been found; and that by these examples it was proved how truly the Association kept to the real purpose of its foundation, "the Advancement of Science," and how heartily it rejoiced in this advancement without looking too closely to its own share in the triumph. Here, indeed, is the stronghold of the British Association. Wherever and by whatever means sound learning and useful knowledge are advanced, there to us are friends. Whoever is privileged to step beyond his fellows on the road of scientific discovery will receive our applause, and, if need be, our help. Welcoming and joining in the labour of all, we shall keep our place among those who clear the roads and remove the obstacles from the paths of science; and whatever be our own success in the rich fields which lie before us, however little we may now know, we shall prove that in this our day we knew at least the value of knowledge, and joined hearts and hands in the endeavour to promote it.

ACADEMY OF SCIENCES.

September 4.

M. Béchamp presented a memoir "*On the Ageing of Wines.*" In his lectures on the vinous fermentation the author has said that all the acids, alcohols, ethers, and even extractive matters in wine may react on each other in the course of time, and produce the alterations of colour, flavour, and bouquet which, when achieved, constitute the peculiarities of old wines. Recent writers, and M. Pasteur in particular, contest the truth of this statement, and their writings, M. Béchamp thinks, tend to put wine producers on a wrong path. The author's object in this memoir appears to be to advise wine makers to continue in the old way, to allow wine to ripen for a time in the wood, and then to bottle. In opposition to M. Pasteur, he asserts that the cause of the improvement of wine by age is a fermentation provoked by organisms developed after the alcoholic ferment properly so called; and he states that wine is improved by an influence analogous to that which spoils it. The whole secret of improving wine, he says, is to favour the production of the "benevolent" organisms. What these are he does not tell us: all the author states is that they are very small and very mobile. Wine, he tells us, is improved by a heat which does not destroy these animals, but exaggerates their functions.

M. Jeannel gave an account of some "*Researches on Supersaturated Saline Solutions.*" The author states, in opposition to MM. Gerenz and Viollette, that the crystallisation of supersaturated solutions is not determined by saline particles floating in the air. He states that in vessels with narrow mouths, crystallisation is completely prevented, although access of air is allowed; and a solution of tartrate of soda will crystallise in a sealed vessel. The solid walls of the vessels have an important influence on the crystallisation. When the extent of these predominate over the solution crystallisation never takes place. A hot supersaturated solution of sulphate of soda placed in drops on a glass plate cools without crystallising; under the same circumstances, a supersaturated solution of alum dries up.

M. Carret has a note "*On the New Epidemic in Savoy,*" in which he reasserts the cause of this disease to be the carbonic oxide produced by the cast-iron stoves. His nephew, M. Jules Carret, has proved the presence of the gas in a room heated by a cast-iron stove.

M. Fougué communicated, through M. St. Claire Deville, several analyses of "*Gases evolved from Springs around Mount Etna.*" In some of these marsh gas predominated, in others carbonic acid, and in a few nearly pure nitrogen was collected.

M. Maurand submitted to the Academy an instrument which may prove of great value. He calls it a "*Ready Reckoner* (*prompt calculateur*), and it is intended to reduce with ease and accuracy the weights and measures of all nations to the French metric equivalents, and *vice versa*.

The cholera still occupies many of the correspondents of the Academy. M. Espagne writes from Montpellier that mild mercurialisation is a certain preservative from the disease; and M. J. F. Saunders sends a prescription which was very useful in 1849.

NOTICES OF BOOKS.

Annales de Chemie et de Physique. July, 1865.

This journal, although dated July, has but just reached us. It contains an article by M. Berthelot "*On a New Class of Isomers—Kenomers.*" We gave a short notice of this paper some time ago on its appearance in the *Comptes Rendus*, but its interest may justify a fuller abstract on a future occasion. The next paper is by M. Brassier, "*On the Changes which Cheese Undergoes with Age.*" The author shows that in cheese, both salted and unsalted, a considerable amount of leucine and other bodies soluble in alcohol are formed at the expense of the caseine, fatty matters, and lactine originally present. A translation of a memoir by Bischof "*On the Stassfurth Salt Mines*" follows. These mines, our readers will remember, contain a deposit of chloride of potassium, and have had an important influence on the production of potash compounds. The geological part of Bischof's paper is of great interest. The last article is the commencement of a paper of much value by Dr. Icery, of Mauritius, "*Researches on the Juice of the Sugar-Cane, and the Changes it Undergoes during the Manufacture of Sugar.*" When this paper is concluded we shall give an abstract.

Journal de Pharmacie et de Chemie. August, 1865.

This journal contains a long report by Guibourt "*On Pepsine.*" It really contains nothing of importance, but as it gives the process of M. Boudault introduced into the Codex, we shall make a short abstract. In a note "*On Detonating Antimony,*" M. Nicklès, in opposition to Mr. Gore, states his belief that the explosiveness depends upon the presence of a chloride of antimony—analogous to chloride of nitrogen. M. Schaeuffèle publishes a note, in which he states that he has found sulphate of indigo in loaf sugar. The sugar bakers have borrowed an idea from the washerwoman. M. Dénian gives some "*New Formulæ for the Internal Administration of Silver.*" He makes a mixture of nitrate of silver, bromide of potassium, white of egg, syrup, and peppermint water, which probably no one will ever think of administering. The other papers in this number we have already noticed.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

1947. P. A. F. Bobœuf, Paris, "Improvements in the preparation and application of certain colouring matters."—Petition recorded July 27, 1865.

1040. A. Millochan, New York, U.S.A., "An improvement in stills for the distillation of petroleum and other oily substances."—August 5, 1865.

2070. L. Schad, Warrington, Lancashire, "Improvements in the production of violet colours from magenta for dyeing, and printing."—August 9, 1865.

2071. M. H. Blanchard, Blackfriars Road, "Improvements in the manufacture of terra cotta or vitreous stone."—August 10, 1865.

2096. R. A. W. Westley, Camden Road, Camden Town, "A combination of improved method, apparatus, and receptacles for storing, preserving, transferring, and discharging certain fluids for sanitary and protective purposes." A communication from H. Pinkers, Boulogne.

2100. J. T. Lockey, Sutton, Lancashire, "Improvements in and connected with the manufacture of copper."—August 14, 1865.

2118. W. West, St. Blazey, Cornwall, "Improvements in preparing lubricating compounds."—August 16, 1865.

Notices to Proceed.

1141. W. E. Gedge, Wellington Street, Strand, "An improved pessary."—A communication from L. A. Rigaux, Paris.—Petition recorded April 24, 1865.

1153. J. N. Brown, Handsworth, and T. D. Clare, Birmingham, "Improvements in the manufacture of iron and in preparing fuel to be used in the manufacture and melting of iron."—August 25, 1865.

1193. R. Ferrie, J. Murray, and A. Wilson, Paisley, "Improvements in dyeing yarns."

1198. T. White, Camden Town, "Improvements in apparatus employed in the reburning of animal charcoal."—April 29, 1865.

1286. J. H. Johnson, Lincoln's Inn Fields, "Improvements in the manufacture of paraffine candles."—A communication from A. E. Pearson, Paris.—May 9, 1865.

1386. W. Davey, Hackney Wick, "Improvements in apparatus for washing or purifying coal gas, and for producing ammoniacal water therefrom."—May 19, 1865.

CORRESPONDENCE.

Continental Science.

Paris, September 12.

I see in *Les Mondes* a short description of an ice-making machine now in operation here. The inventor, M. Menard, employs amylic ether, which is compressed to the extent of from five to seven atmospheres. From the reservoir the liquid is allowed to escape into a worm circulating round square vessels of water which becomes frozen by vaporisation of the ether in the worm. There is, to say the truth, some confusion in the account given, and the details cannot be trusted. The machine will produce, it is said, 50 kilos. of ice per hour.

I read, also, that all difficulties in the way of producing a constant light by induction machines have now been overcome by the Alliance Company, and the two lighthouses at Havre will now be definitely illuminated by the Company. The machines will be driven by a six-horse-power locomotive engine, which will also compress air for whistles or trumpets to be used as fog signals.

An important experiment has been made by M. Duchemin during a holiday at the sea side. He made a small cork buoy, and fixed to it a disk of charcoal containing a small plate of zinc. He then threw the buoy into the sea, and connected it with copper wires to an electric alarum on the shore. The alarum instantly began to ring, and has gone on ringing ever since, and it is added that sparks may be drawn between the two ends of the wires. Thus the ocean seems to be a powerful and inexhaustable source of electricity, and the small experiment of M. Duchemin may lead to most important results.

It is said on the authority of a Dr. Brandini, that lemon-juice, or a solution of citric acid, relieves the pain of cancer when applied to the sore as a lotion. The discovery was made accidentally, and the value of the application was confirmed by repeated experiments.

MISCELLANEOUS.

British Association.—As we go to press the successful meeting at Birmingham is closing, and the members are scattered about on the various excursions. In our next we shall commence our reports of the papers read in the chemical sections, and others in which communications of interest to our readers have been made. As was to be expected, the manufacturers of Birmingham have been very liberal in opening their establishments to the inspection of the members—a privilege of which they have not been slow to avail themselves, and for which the manufacturers deserve our best thanks. The following papers were read after the delivery of the President's Address:—

SECTION B.—CHEMICAL SCIENCE.

H. C. Sorby—On a new form of Spectrum Apparatus as applied to the Microscope.

F. A. Abel—Notes on Compounds of Copper and Phosphorus.

Dr. A. Voelcker—On the Composition of a Marine Boiler Deposit.

Dr. T. Phipson—On Silicium in Iron.

Dr. T. Phipson—On the Sublimed Oligist of Vesuvius and its Artificial Production.

Dr. T. Phipson—A few words on Sponges as a Source of Bromine and of Nitrogen.

Dr. Angus Smith—On a Method of Estimating Carbonic Acid in the Air, with Apparatus.

Dr. Williamson—Report on the Analysis of the Gases evolved from the Bath Waters.

F. Crace Calvert—Notes on the Action of Acids on some Metals and Alloys.

Dr. J. E. de Vry—On the possibility of Manufacturing Neroli in the British Colonies.

Owen Rowland—On the Properties of Parkesine, and its Application to the Arts, Manufactures, and Telegraphy.

F. G. Finch—On the Utilisation of Blast Furnace Slags.

Dr. A. Voelcker—On recently-discovered Phosphatic Deposits in North Wales.

Dr. Frankland—On the Constitution of the Acids of the Acetic, Lactic, and Acrylic Series.

Professor Wanklyn—Report on some of the Differences between the Normal and the Beta Alcohols.

Dr. D. S. Price—On the Action of Light upon Sulphide of Lead, and its bearing upon the Preservation of Paintings in Picture Galleries.

Report of the Committee on Gun Cotton.

Manning Prentice—The Progress of the Manufacture of Gun Cotton and its application to Mining, Military, and Sporting Purposes.

W. L. Scott—On Action of Alkali Metals on Gun Cotton.

W. L. Scott—On Arseniuretted and Antimoniuretted Hydrogens.

Smyth, J., jun.—On an Apparatus for the determination of Ozone, and experiments made therewith.

Dr. de Vry—On the Rotatory Power of several Essential Oils.

Dr. Macadam—On Esparto Fibre, or Spanish Grass, and its employment in the manufacture of paper.

Dr. Macadam—On the Results of Agricultural Experiments made in 1864.

D. Forbes—On some Minerals from South America. On the Colour of Gold as seen by transmitted light.

T. Fairley—On the Reactions of Cyanogen. Note on Glycocine, with tables.

Adulteration of Dutch Yeast.—At a meeting of the Sanitary Committee of the Hull Board of Health, held on Wednesday, the chairman stated that his attention had been called by an anonymous letter to the adulteration of Dutch yeast. The letter stated that the recent importations of yeast contained a large admixture of China clay, which was ground as fine as flour by a machine. The chairman remarked that this kind of adulteration occurred a few years ago, and he had reason to believe that it was again being extensively practised. The same anonymous correspondent had again written to him to say that two importers at Bradford had written to the agents on the Continent, telling them that it was very likely that the whole of the next importation would be seized unless the quality was improved, and there was an improvement in the next cargo. The inspector stated that the cargo spoken of as improved was one of the worst samples that had been sent to Hull for some time. He had made inquiries, and had collected samples, some of which he had dissolved in water, when there sank to the bottom of the vessel a mineral substance. This substance was produced, and pronounced by two surgeons, who are members of the Committee, to be a kind of aluminous earth. It was resolved that the substance be sent to an analytical chemist for inspection. The average import of Dutch yeast in Hull is about 7000 baskets per fortnight, and during the past fortnight 123 baskets of yeast had been destroyed as unfit for human consumption. The chairman said the Board had no power to interfere with the adulteration if it could not be proved deleterious. If the substance on analysis was found to be injurious, the Board would take prompt steps to remedy the evil.

North London Industrial Exhibition.—Among the rich displays of optical instruments at the Agricultural Hall, the first that will attract notice is the large case of Mr. T. Ross. This contains a selection of telescopes, microscopes, and photographic lenses of that excellence and finish for which the maker is famous. Among the photographic lenses are some specimens of the new actinic large-angle doublet, of which we may speak more particularly since some pictures hanging beside the case, and others in the gallery upstairs, are exhibited to show the capabilities of these lenses. We may say, shortly, that the marvellous beauty of these pictures has never been equalled. As the name implies, the doublet is remarkable for the very wide angle of view it embraces. This is well shown in the views of different courts in the Crystal Palace, which could only have been taken by a lens of this kind; and the special adaptation of the lens for taking buildings will be at once apparent to the photographer, who will further remark the sharpness of definition to the very edge of the pictures. Famous as Mr. Ross has been as a maker of lenses, this last is certainly his most valuable contribution to the art of photography. The visitor should particularly notice the copy of a map of France made with the doublet, as sharp, clear, and legible as the original engraving. Mr. Ross also exhibits one of Monckoven's enlarging apparatuses, with specimens of untouched pictures taken by means of it. M. Dallmeyer exhibits a case of photographic lenses, well made, of course, but including nothing novel. Mr. How has an extensive display of all kinds of apparatus, among which is the only spectroscope in the Exhibition. This is an excellent instrument, of Bunsen and Kirchoff's form, and is a very useful and cheap piece of apparatus. Mr. How also exhibits a student's microscope, a very well-made instrument, with sliding stage and rapid and slow motion to body, two eye pieces, and a quarter and one-inch object glasses of excellent quality. There are besides a condenser, live-box, and other additions, which make this an exceedingly cheap instrument. Some useful little chests containing blowpipe tests for mineralogists are shown, and a delicate pocket aneroid compensated for temperature for travellers. Some models of crystals in glass, showing the primary and included forms, also deserve a notice as exceedingly useful for educational purposes. Several other cases in this interesting exhibition yet require a notice, but these we must reserve for another occasion.

ANSWERS TO CORRESPONDENTS.

D. T. O.—Melted sulphur and sand.

H. F.—Treatment with sulphuric acid and bichromate of potash would probably effect the first object; for the second, what you suggest would probably answer. Try a greenish oil.

M. A. W.—1. A process does not occur to us now, but we will look for and give it next week. 2. Subscribe to the Meteorological Society, wh forward reports.

Books Received.—"Practical Treatise on Coal, Petroleum, and other Distilled Oils," by G. A. Gesner, second edition; "Scientific Review;" "Proceedings of the American Pharmaceutical Association, 1864;" "Dictionary of Chemistry," Part XXX.

Received.—Thallium.

BRITISH ASSOCIATION.

Address to the Section of Chemistry, by the President, Professor W. A. Miller, *M.D., LL.D., Treas. and V.P.R.S., President of the Chemical Society.*

Interesting historical associations are naturally awakened in the mind of the chemist as he enters upon the business of this section of our scientific gathering in the town whose hospitalities we are now sharing; for he is reminded that on August 1, 1774, only ninety-one years ago, Priestley laid, at Birmingham, the foundation of modern chemistry, by the discovery of oxygen.

Yet it seems difficult to realise the fact that there must be some still living who entered life when the chemical nature of the atmosphere was undiscovered, when water was believed to be an elementary substance, when the composition of the ordinary acids, nitric, hydrochloric, and acetic, was unknown, when the discoveries of Galvani had not been made, and when the battery which perpetuates the name of Volta did not exist.

It requires a considerable mental effort to estimate aright the extraordinary progress which chemistry, both in its scientific and in its practical aspect, has made since that day.

For example, the development of the laws of combination—the determination of the equivalent proportions of the elementary bodies—the art of chemical analysis—the atomic theory—the isolation of potassium, with the consequent discovery of the compound nature of the alkalies and earths—and the marvellous developments of the organic department of chemistry, exhibit some of the most striking points in the progress of the science; whilst in the chemical arts we may mention gas-lighting—the manufacture of stearic acid and other fatty acids for candles—the industry of petroleum and paraffine—the chemical process of bleaching by chlorine—the preparation of carbonate of soda from common salt, and the extensive alkali trade. The discovery of iodine and bromine, and their varied applications as remedial agents and otherwise—the fascinating processes of photography—the development of the trade in beetroot sugar—the extraction of quinia, morphia, and all the vegetable bases,—these and other processes of chemical manufacture too numerous to mention, are all subsequent to, and may be said to be in nearly every case consequent on, the great discovery of oxygen.

Well may we sympathise, now, in the sanguine anticipations of Priestley himself, expressed in the preface to the volume in which this discovery is recorded, "Experiments and Observations on Different Kinds of Air," vol. ii., p. 7:—"In reality, this is not now a business of air only, as it was at the first; but appears to be of much greater magnitude and extent, so as to diffuse light upon the most general principles of natural knowledge, and especially those about which chemistry is particularly conversant. And it will not be now thought very assuming to say, that, by working in a tub of water or a basin of quicksilver, we may perhaps discover principles of more extensive influence than even that of gravity itself, the discovery of which, in its full extent, contributed so much to immortalise the name of Newton."

But it is not alone with the name of Priestley that we associate the progress of chemistry in Birmingham. Grouped around the father of pneumatic chemistry were several remarkable men who then either resided at Birmingham or frequently met there, including Matthew Boulton, James Keir, Dr. Withering, Dr. Darwin, and, foremost of them all, James Watt, who here diversified his engineering labours with his famous investigations into the composition of water. It was at the factory at Soho, too, that Murdoch made the first great experiment on gas-lighting, at the illuminations for the short-lived peace of Amiens; and it was in Birmingham that Dr. Roebuck, in the middle of the last century, erected the first leaden chamber for the making of sulphuric acid, and thereby inaugurated the most important of the chemical manufactures of this country.

Nor has Birmingham failed in more modern times to maintain her reputation in connexion with the chemical arts. Here, twenty-five years, ago, Elkington founded the first establishment, in this country, for carrying out the processes of electro-plating and electro-gilding. Here Askin made the nickel of commerce, with its companion metal, cobalt, as oxide—articles that might vie in purity with the products of the laboratory. Here Chance has established a manufactory of optical glass which specially calls for acknowledgment on the part of the student of science; and here Sturge and Albright have erected the only manufactory for red phosphorus which the country contains.

Vast as is the modern development of experimental science, it yet cannot excite much surprise that, with the exception of that portion which falls within the domain of the mathematician, science until recently has been systematically excluded from the general course of education, and has been followed in the majority of instances by those only who commenced its study for professional objects. Yet can we wonder at this, when we remember that the science of chemistry and many entire branches of experimental physics, including voltaic electricity, electro-magnetism, thermo-electricity, the phenomena of polarised light, of photo-chemical action, radiant heat, and others, are, as already stated, less than a century old? But the great strides that they have made in that interval, the social changes that they have introduced, and the additional powers that they have conferred upon man, will vindicate their importance as necessary branches of knowledge to be acquired; whilst the more just appreciation of the methods of investigation which they pursue will establish their claim to be regarded as instruments in training the mind, and shaping the intellectual development of the future.

Those whose education was based upon the linguistic system almost exclusively, as was the case both before and after Priestley's time, could not be expected to realise the magnitude and true bearing of science and its educational value. Now, however, the case is altered; and it is a subject for congratulation to reflecting men that the introduction of the scientific element into the ordinary course adopted at our public schools is at length attracting serious attention, and that its importance has been insisted on in both Houses of the Legislature. The practical instinct of the nation is becoming alive to the necessity of making certain portions of the training of our youth consist in the systematic study of the elementary parts of properly selected branches of science; and it behoves all who are themselves engaged in the pursuit of science to consider in what way they can themselves aid in forwarding this object.

I need not here advert to the exploded notion that the acquisition of the truths of science can in any wise endanger those of revelation; for truth is ever consistent. But it may not be superfluous to reassure the minds of some who imagine that science, like a fresh invasion of Vandals, will extinguish scholarship and classical learning. Language must indeed ever form the basis of

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our system of education; for it is the key that unlocks the stores of knowledge; and no languages are so fitting to form the groundwork as the tongues of ancient Greece and Rome, irrespective of the treasures of philosophy, eloquence, poetry, and history which they contain. They have that intellectual finish and completeness which belongs only partially to science. A moderate amount of classical knowledge can be, as, indeed, it ought to be, attained by every so-called educated mind, while for him who would carry the critical faculty to a high state of cultivation, the study of the classics affords the means. These tongues constitute the basis of many of the modern European languages; and an acquaintance with their literature imparts a cultivation and a polish that it is almost vain to seek from any other source. Just as some minds seek to attain distinction in the wide domain of philology, other minds, as vigorous, though differently constituted, delight in the study of natural laws and affinities. It would be a hard thing to say that provision should not be made in our schools for the latter, as wide and liberal as it has been for the former.

It is not to be supposed that, because science is to form a part of the education of every gentleman, therefore it will constitute the pursuit of his mature years. What is needed is that he possesses sufficient knowledge of its principles to qualify him to appreciate the advances which science is making, and to enable him to contribute intelligently towards its progress.

It is certain that if science is to form a useful portion of the education of a boy, it must be undertaken with the determination to deal with it as a matter of study: the same pains must be taken to ascertain that each boy understands the principle, for example, of the air pump, or the meaning of the thermometric scale, as that he comprehends a rule in syntax or the analysis of a sentence. To do this, however, the instruction given must not be limited to a dry lecture on the principles of some branch of science once a week. These principles must be logically unfolded, and illustrated, when necessary, by experiments, and the structure of machines and apparatus explained by suitable diagrams; the boys must be taught to take notes of each lecture; and the ground covered must be made secure by following up the lectures with frequent examinations, both oral and written. These are as necessary to the successful study of a science as the writing of exercises, or the practice of construing, is to the accurate study of a language. Science is not merely to supply her facts; she is to be employed to develope the powers of the mind, and to discipline them for action. Hence it is of far more importance to instil principles, and to cultivate precision in observation, in thought, and in description, than it is to load the memory with mere facts, however valuable. In short, the system of cramming is to be eschewed, whilst the formation of habits of comparing, reasoning, and judging is to be encouraged in every way.

It may at first be difficult to meet with well-trained and competent teachers; but when once the want of instruction in science is proclaimed, the teachers will soon be forthcoming. Some years will, no doubt, elapse ere science is admitted to take equal rank, as a means of education, with the study of classical literature. Still it is but a question of time; and we cannot but hope that our universities, following up the commencement which the youngest but not the least active amongst them, the University of London, has made in the establishment of degrees in science—we cannot but hope, I say, that the heads of our universities will ere long feel it to be their duty, as unquestionably it will be their wisdom, to place themselves at the head of this new movement, which is destined to exercise so wide an influence upon the education of our people.

But it is time that we proceed to take a rapid survey of some of the principal points in the progress of chemistry during the last twelve months. The course of chemical discovery since our meeting last year, though not marked by any very striking novelty, has nevertheless been steadily advancing. Ideas previously thrown out have been discussed and developed, and many of them are leading to new discoveries, or are being applied to explain phenomena before wrapped in obscurity.

Amongst the problems which have, for some time past, been engaging the minds of philosophical chemists, few are of greater interest than those connected with the idea of the atomicity of the elements. It is well known that chemists now distinguish between the atomic weight and the equivalent of an element; also, that owing to the labours of many distinguished men, amongst whom the names of Williamson, Kekulé, Odling, Cannizzaro, and Wurtz are the most prominent, a classification of the elements into families has been made; and that this classification rests upon what is known as the atomicity of the elements. One group of the elements, like potassium and chlorine, is regarded as monatomic, or usually equivalent in functions to one atom of hydrogen; a second, like oxygen and sulphur, is diatomic, or equivalent in functions to two atoms of hydrogen; a third group, like nitrogen, phosphorus, and arsenic, is triatomic or equivalent for the most part to three atoms of hydrogen; while a fourth group, like carbon and silicon, is tetratomic, or equivalent in functions to four atoms of hydrogen, and so on.

It would lead us too much into detail, were I to attempt to show how this idea of the atomicity of the elements has been applied, and is still in process of application, to the study of the formation of compounds in general, how it endeavours to explain the existence of a limit to their number, and how it even teaches us to anticipate their possible varieties.

Among the subjects connected with its development is its bearing upon isomerism, or the remarkable fact of the existence in many cases of two or more bodies of different properties but yet composed of the same elements combined in identically the same proportions. Upon this subject, which, at our last meeting, was characterised by Dr. Odling as the chemical problem of the day, a suggestive theoretical paper was published, about twelve months ago, by Dr. Crum Brown; whilst, in the same direction, Cahours, Kekulé, Beilstein, Fittig, and several other chemists have published valuable experimental researches. Inquiries of this kind are now acquiring special importance from the numerous cases of the formation of such isomeric bodies by the methods of synthesis and substitution, which are daily multiplying.

Closely connected with the same subject are the investigations into the constitution of the more complex organic acids, which have been prosecuted so actively during the last five or six years, and which, in the hands of Kolbe, Franklin, Perkin and Duppa, Kekulé, Wurtz, and their pupils, have made such rapid progress.

During the past year Frankland and Duppa have especially signalised themselves by their researches upon the lactic and the acrylic series. Two years ago, Frankland, commencing with oxalic ether, and acting upon it with zinc ethyl, obtained from it leucic ether by substituting ethyl for a portion of the oxygen contained in the oxalic ether; and afterwards, conjointly with his friend Duppa, he has generalised this reaction. Still more recently, these chemists have traced the connexion between the lactic and the acrylic or oleic series, by reactions in which the abstraction of the elements of an atom of water from the basylous portion of a member of the lactic group converts it into the corresponding member of the acrylic series. These relations will be readily understood by representing the different compounds by symbols, as follows:—

$$(1)\ \overbrace{H_2\not{C}_2\Theta_4}^{\text{Oxalic acid.}} + (\not{C}_2H_5)_2 - \Theta = \overbrace{H,H\not{C}_2(\not{C}_2H_5)_2\Theta_3}^{\text{Leucic acid.}}.$$

$$(2)\ \overbrace{H_2\not{C}_2(\not{C}_2H_5)_2\Theta_3}^{\text{Leucic or diethoxalic acid.}} - H_2\Theta = H,\overbrace{\not{C}_2(\not{C}_2H_5)(\not{C}_2H_4)''\Theta_2}^{\text{Ethylcrotonic acid.}}.$$

In these and kindred investigations, the necessity for the introduction of fixed principles of nomenclature for regulating the construction of names for the recently discovered compounds has been sensibly felt; and indeed the changes in notation rendered necessary by the alteration in the values assigned to the atomic weights of many of the chemical elements have rendered a general revision of the system of chemical nomenclature a matter of pressing importance. Probably few subjects could more usefully occupy a portion of the time of this section during the ensuing week than a thoughtful consideration of the changes which it may be expedient to introduce. The meeting of chemists from various parts of Europe with many from distant parts of our own country affords an excellent opportunity for discussing a subject of this kind, where any conclusions, to be practically effective, must secure the concurrence of a majority of the active cultivators of the science.

Did time permit, it would be easy to mention other investigations in the organic department of chemistry, scarcely less interesting than those already alluded to, such as those on the synthesis of the aromatic acids by Kekulé, who has prepared both benzoic and toluic acid by the graduated action of sodium on an ethereal solution of bromo-benzol, and of bromo-toluol whilst submitted to a current of carbonic anhydride, as, for instance, may be explained by the equation—

$$\overbrace{\not{C}_6H_5Br}^{\text{Bromobenzol.}} + Na_2 + \not{C}\Theta_2 = \overbrace{Na\not{C}_6H_5(\not{C}\Theta_2)}^{\text{Sodic benzoate.}} + NaBr.$$

or such as those of Maxwell Simpson and of Baeyer on the artificial formation of tribasic acids; and, referring to methods of research, stress might be laid on the important aid afforded by the extended use of the amalgam of sodium as a reducing agent, and on the similar but still more remarkable reducing effects of hydriodic acid —processes, indeed, not new, but the value of which till quite recently has only been partially recognised.

Passing allusion only can now be made to some of the processes of mineral and metallurgic chemistry, such as the improvements in the details of the process for preparing magnesium, the comparative facility with which the recently discovered metals thallium, rubidium, and cæsium and their compounds may be obtained, and the application by Redtenbacher of his observation of the sparing solubility of their alums to the extraction of the new alkalies from the lithium residues of commerce. Of indium, too, the latest of the newly discovered metals revealed by the spectrum, it must suffice to say that it has been obtained in quantity which places its existance as a distinct metal beyond question. I am indebted to my friend Professor Roscoe for the small specimens of the metal and its sulphide now upon the table.

An extensive branch of industry is now springing up in the improved methods of voltaic depositions of the metals. Weil has, by the use of an alkaline solution of tartrate of copper, contrived to coat iron and steel with a tough closely adherent sheathing of copper, by simply suspending the articles to be coated by means of a wire of zinc in the metallic bath. No battery is required. Lead and tin may in a similar manner be deposited on copper, iron, or steel, if the oxide of tin or of lead be dissolved in a bath of strong solution of caustic soda.

I must, before I conclude, advert to one or two interesting additions to our knowledge upon the side where chemistry and physics meet. Few results, perhaps, were more unexpected than those obtained by Deville and Troost upon the permeability to gases of certain dense metals at elevated temperatures. They have proved that platinum and iron, when white-hot, become for the time porous, and are rapidly permeated by hydrogen, which will even pass out under the pressure of the atmosphere and leave a vacuum almost perfect within the tube. In one form of these experiments, tubes of hammered and of cast platinum (which in one case was as much as a twelfth of an inch in thickness) were fitted by means of corks into the axis of a shorter and wider tube of glazed porcelain; a slow current of pure and dry hydrogen was then maintained through the porcelain tube, whilst a current of dry air was transmitted through the platinum tube. At ordinary temperatures no change was observed in either gas. A fire was then lighted around the outside of the porcelain tube, and gradually raised until the heat became very intense. At 2000° Fahr. the oxygen contained in the air had entirely disappeared; nothing but nitrogen mixed with steam passed out of the platinum tube, hydrogen had passed through the pores of the platinum and entered into combination with the oxygen of the air within; whilst at still higher temperatures the moist nitrogen became mixed with hydrogen. As the tube cooled, the same phenomena occurred in the inverse order, till, when the ordinary temperature had been regained, no diffusion of hydrogen was perceptible, and unaltered air was collected from the platinum tube. Analogous results were obtained when a tube of soft cast steel was substituted for that of platinum, though the thickness of the steel tube was an eighth, or in some cases as much as a sixth of an inch.

From these experiments one practical conclusion deducible is, that air-pyrometers, the bulbs of which are formed of iron or platinum, cannot be relied on when employed for measuring elevated temperatures; glazed porcelain, however, was found to confine the gases completely.

Curious as these results are, they are but parenthetical in another series of more general bearing, in which Deville has for some time been engaged—viz., the phenomena of dissociation, as he has termed the partial decomposition which compound gases experience under the influence of a temperature more or less elevated.

A very striking result was obtained by the use of an apparatus similar to that employed in the experiments just described, but in which a brass or silvered tube was substituted for the platinum or iron tube. A rapid flow of water was maintained through the metallic tube, so that it was kept quite cool, whilst the outer porcelain tube was gradually raised to an intense heat as before. On transmitting a current of pure and dry carbonic oxide through the porcelain tube, the lower part of the surface of the cold metallic tube became covered with deposited carbon, whilst a portion of the carbonic oxide, by combining with the oxygen previously united with this carbon, became converted into carbonic anhydride.

Sulphurous anhydride was by similar treatment resolved into sulphur and sulphuric anhydride; and even hydrochloric acid was partially separated into hydrogen and chlorine. These experiments are intimately connected with the attempts made to explain the cause of certain exceptions to Ampère's law, that equal volumes of gases or vapours contain the same number of molecules of each. Chemists now generally assume that the molecule, both of simple and of compound bodies, forms two volumes of vapour, and consequently that the molecular weight of any substance corresponds with the number which represents twice its density when referred to the density of hydrogen, if this be taken as unity. But there are exceptions to this law: pentachloride of phosphorus, hydrochlorate of ammonia, hydriodate of phosphuretted hydrogen, and various other bodies, instead of forming two volumes when one molecule of each is converted into vapour, yield four volumes.

In order to explain these anomalies, Kopp and Cannizzaro suppose that, at the temperature at which the vapour-densities of these compounds are observed, the bodies are temporarily decomposed, and, instead of forming one homogeneous vapour, are at the time of the observation really composed of a mixture of vapours. In certain cases this explanation is probably the true one; but its general acceptance has been disputed by Deville himself, though his results on dissociation seem, to cursory observation, to be in its favour; and it must be admitted that, up to the present time, the arguments and experiments which he has brought forward in opposition to the views of Kopp and Cannizzaro have not been satisfactorily answered.

No sufficient proof, for example, has yet been adduced that the well-known anomalous cases of nitric oxide, chlorous anhydride, hydrosulphide of ammonium, cyanine of ammonium, and various other salts of ammonium and the volatile bases are due to dissociation of their components.

This subject is one, however, too intimately connected with the molecular theories at present under discussion to remain long in its actual state. New experiments and evidence will no doubt be forthcoming, which will throw further light upon the cause of these outstanding exceptions.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On a New Series of Bodies Intermediate between Nitric Acid and Ammonia, by Dr. A. W. HOFMANN, *F.R.S.*

IN the course of a discussion on a paper read at the Birmingham meeting of the British Association, Section B, by Dr. C. Calvert "On the Action of Acids on some Metals and Alloys," Dr. Hofmann asked Professor Calvert whether, in his experiments on the action of acids, and more especially of nitric acid, upon the metals, he had met with some of the extraordinary bodies lately observed by Dr. Lossen. This young chemist, at one of the late meetings of the Berlin Academy, had laid before that body an account of several substances which had attracted general attention. It was well known that among the products of the action of nitric acid upon certain metals ammonia invariably occurred. But it appeared that ammonia was only the last product of the reaction, and that a whole series of intermediate compounds existed between nitro-ammonia acid, the substance acted upon, and the last product of its reduction. One of these bodies Dr. Lossen had succeeded in isolating. It was a compound which, from its composition, might be termed protoxide of ammonia, having, in fact, the formula H_3NO. This substance, like ammonia, combined with acids, producing a series of magnificent salts remarkable for the facility with which they crystallise. The simplest method of producing this interesting compound consisted in submitting nitrate of ethyl to the action of metallic zinc in the presence of an acid. It would be observed that the derivation of the new body from nitric acid was perfectly analogous to that of aniline from nitrobenzol.

Nitrobenzol.	Aniline.
$C_6H_5NO_2$	$C_6H_5NH_2$
Nitric acid.	Hydorylamine.
HO,NO_2	HO,NH_2

The new body might be looked upon as ammonia, in which one atom of hydrogen is displaced by what might be called the rump of water, the atomic group HO, which by some had been called hydroxyl, by others hydoryl.

Ammonia.	Hydorylamine.
$\left.\begin{matrix}H\\H\\H\end{matrix}\right\}N$	$\left.\begin{matrix}HO\\H\\H\end{matrix}\right\}N$

It was certainly interesting to see the simplest of reactions, familiar to every chemist, still yielding a harvest of such splendid results.

On Some Salts of the Peroxide of Thallium, by A. STRECKER.*

THE compounds of thallous oxide with acids have been for the most part studied and described, but little has been said of the salts of thallic oxide (TlO_3), except that they are hygroscopic and easily decomposable. The author, therefore, prepared some of the salts, and submitted them to investigation. He prepared the oxide by adding hypochlorite of soda to a solution of thallous chloride in carbonate of soda. The two solutions, when mixed in the cold, gradually deposited a brown precipitate of thallic oxide, which was washed by decantation. A boiling saturated solution of thallous chloride in carbonate of soda added to hypochlorite of soda gives a dark brown precipitate of thallic oxide, usually mixed with a small quantity of chloride, which may, however, be changed into peroxide by digesting the precipitate with hypochlorite of soda.

According to Lamy, the peroxide precipitated by an alkali from the perchloride retains, after drying at 100° C., one equivalent of water; but Strecker found the entire loss, on heating the oxide to redness in a stream of dry air, was only 0·6 per cent.; the formula $TlO_3 + HO$ would require 3·8 per cent. of water.

Thallic Sulphate.—Thallic oxide easily dissolves in warm dilute sulphuric acid. On evaporating the solution, thin, colourless plates separate from the concentrated liquor; these must be collected on a filter paper and separated from the mother liquor by pressure; washing with water decomposes the salt. Dried in the air, the salt has the composition $TlO_3,3SO_3 + 7HO$; at 220° it loses six equivalents of the water, and becomes $TlO_3,3SO_3 + HO$.

Sulphate of Thallic Oxide and Soda.—A solution of thallic sulphate in dilute sulphuric acid added to a saturated solution of sulphate of soda gives colourless

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* Abstract *Annalen der Chem. und Pharm.*, Aug., 1865, p. 207.

needles, which may be washed with cold water, pressed, and dried over sulphuric acid. The results of the analysis of the crystals agree with the formula

$$TlO_3,3SO_3 + NaO.SO_3.$$

Sulphate of Thallic Oxide and Potash.—A mixed solution of thallic sulphate in dilute sulphuric acid and acid sulphate of potash becomes cloudy, and after a time deposits a crust of hard, colourless crystals, having the composition $TlO_3,2SO_3 + 2(KO,SO_3)$.

Oxalate of Peroxide of Thallium and Ammonia.—Oxalate of ammonia added to a solution of thallic sulphate in dilute sulphuric acid gives a heavy, white precipitate, quite insoluble in cold water. When boiled in water, however, it dissolves, carbonic acid is evolved, and a salt of thallous oxide is formed. Dried in the air, the compound has the formula

$$TlO_3,3C_2O_3 + NH_4O,C_2O_3 + 6 \text{ aq}.$$

Heated to 100°, it becomes oxalate of thallium and oxalate of ammonia, and no longer contains a trace of peroxide. On heating the double salt in a test-tube the metal is reduced, and is easily run into a single button.

Peroxide of thallium freely dissolves in nitric acid sp. gr. 1·4 when gently heated, and forms a clear thickish liquid, which may be diluted with a considerable amount of water without becoming turbid. The concentrated solution yields well-formed crystals, which must be separated from the mother liquor by pressure, since water decomposes them. They have the composition $TlO_3,3NO_5 + 6$ aq.

Tartaric acid alone gives no precipitate with an acid solution of sulphate or nitrate of peroxide of thallium, but on the addition of ammonia a cheesy precipitate is formed, which, on the further addition of ammonia and before the solution becomes alkaline, redissolves. On boiling this solution the brown peroxide is deposited.

A solution of tartaric acid, boiled with the peroxide of thallium, dissolves it with effervescence, carbonic and formic acid being produced. The solution, on cooling, deposits crystals of thallous tartrate.

A solution of thallic sulphate gives, with a yellow precipitate with chromate of potash, which decomposes when washed with water, thallic oxide being separated.

A solution of thallic nitrate gives with ferrocyanide of potassium a greenish precipitate, with ferridcyanide a yellow. These precipitates are insoluble in dilute nitric acid.

Phosphate of soda gives with thallic sulphate a white slimy precipitate, which becomes yellowish on boiling. On the addition of ammonia, it dissolves, producing a yellow liquid, from which thallic oxide is separated by boiling.

The ammoniacal solutions with phosphoric or tartaric acid just mentioned, on the addition of sulphide of ammonium, or on passing sulphuretted hydrogen, give a brown precipitate, which, on boiling, collects together, forming a metallic-looking ball. After cooling, this is hard, but it is easily fused by heat, and gives off sulphur. When boiled with dilute sulphuric acid, the precipitate dissolves, sulphuretted hydrogen being evolved, and sulphur separated. The precipitate is probably persulphide of thallium TlS_3.

Iodide of potassium added to the ammonical tartrate solution gives a black precipitate, which is no doubt a periodide, since no iodine is liberated, and no iodide of nitrogen is found in the precipitate. When an excess of iodide of potassium is employed, a good deal of thallium remains in solution, and the filtrate is coloured yellowish-red; this gives no precipitate with hydrochloric acid, and does not colour bisulphide of carbon or chloroform. The black precipitate boiled in the solution in which it is produced quickly changes to yellow, and among the yellow iodide of thallium bright yellow flakes of iodoform may be seen.

On the Qualitative Analysis of Substances Insoluble in Water and Acids, by CHAS. L. BLOXAM.

IN the ordinary course of qualitative analysis the insoluble residue after treatment with water and acids is fused either with carbonate of soda alone, or with the more easily fusible mixture of carbonates of potash and soda. The fusion is generally effected in a platinum crucible or on platinum foil, and often requires a prolonged application of the blow-pipe flame. It is necessary also to submit the substance to a preliminary examination for the easily reducible metals which would corrode the platinum. When such metals are present, a porcelain crucible is employed, when the fused mass becomes contaminated with silica and alumina derived from the crucible, which is often so far corroded as to be useless. With an ordinary gas burner and blow-pipe it is not easy to raise the porcelain crucible to the high temperature required for the fusion.

A great saving of time and labour may be effected by causing the heat to be applied inside the mass to be fused. For this purpose it is mixed with charcoal and nitre in such proportions that complete deflagration and consequent fusion will take place on applying a lighted match. The fusion may thus be effected in a thin porcelain dish without the least injury to the glaze. If the dish be uniformly thin it is not cracked by the deflagration, but if such a dish be not at hand a clean iron sand-tray answers the purpose, the iron being not in the least affected by the deflagrating mixture. The charcoal should, of course, be chosen so as to yield a very small proportion of ash, and must be reduced to a fine powder.[*] Chemically pure nitre is in common use in the laboratory.

A mixture of one part by weight of charcoal with six parts of nitre forms an excellent "deflagrating flux," and may be kept ready mixed for effecting the fusion of insoluble substances. The fused mass remaining after the deflagration is very porous, and therefore easily disintegrated by water, whereas the mass obtained by the ordinary process of fusion by external heat often requires digestion with water for an hour or two in order to extract the soluble part.

The following is the process which I have adopted for the rapid examination of insoluble substances:—Five grains of the substance are intimately mixed with ten grains of dried carbonate of soda, and seventy grains of the deflagrating flux.[†] The mixture is placed in a thin porcelain dish, or clean iron tray, and a lighted match applied to the centre of the heap. The deflagration is completed in two or three seconds, and a well fused mass remains. This is easily detached from the cooled dish (in which a little unburnt charcoal may be left) and boiled with water, being occasionally stirred with a glass rod. Two or three minutes always suffice for the extraction of the soluble portion, which is then filtered off and examined as usual for acids, and for such bases as are compatible in solution with the alkaline carbonates. The residue left by water, after having been washed, is treated with acids and examined in the usual way. A

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[*] Charcoal from the powder mills is most suitable for the purpose.

[†] This appears to be a large proportion of the deflagrating mixture, but the greater part of it will of course pass off during the deflagration.

little charcoal is generally left undissolved by acids, and with it any of the substance which may have escaped decomposition. If it be thought necessary, the dried residue may be ignited until the charcoal is consumed, and the incombustible portion examined.

The only substance which resisted the above mode of treatment was chrome iron ore, but this is not surprising, since this mineral is only partially decomposed even by prolonged fusion in the ordinary manner with the alkaline carbonates.

Quartz sand was rendered almost completely soluble by this process, and by using twice the proportion of carbonate of soda it became entirely so.

Pipe clay was completely fluxed. The aqueous solution of the fused mass contained, of course, very little silica or alumina, which were both found in the gelatinous residue dissolved by hydrochloric acid.

Fluorspar, one of the most troublesome substances under the ordinary mode of fusion, is almost completely decomposed by the deflagration. The aqueous solution, when neutralised with acetic acid, and mixed with chloride of calcium, gives an abundant precipitate of the characteristic fluoride of calcium.

Heavy spar is completely decomposed by the deflagration, yielding sulphates of the alkalies in the aqueous solution, and a residue of carbonate of baryta perfectly soluble in hydrochloric acid. This might be recommended as a convenient laboratory process for the preparation of soluble baryta salts from heavy spar, since the commonest saltpetre, when dried, would answer the purpose.

Tinstone was also rendered in great measure soluble by this mode of treatment. The aqueous solution contained much stannic and silicic acids, whilst the residue furnished a large quantity of soluble binoxide of tin on treatment with hydrochloric acid.

Flint glass was very completely decomposed, some of the lead separating in globules during the deflagration. The aqueous solution contained very little lead, and abundance of silica. The portion left by water dissolved in dilute nitric acid, leaving a few particles of charcoal.

Window-glass was also easily analysed in this way.

Felspar was not so completely decomposed, though abundance of silica and alumina could be detected in the hydrochloric solution from the deflagrated mass.

Chloride of silver was, of course, completely decomposed, the silver separating in the metallic state.[‡]

Sulphate of lead was also completely decomposed, with separation of some metallic lead. Alkaline sulphates were found in the aqueous solution.

Kryolite, as might be anticipated, was very easily decomposed, some of the aluminium being found together with alkaline fluorides in the aqueous solution, while the rest, as alumina, dissolved in hydrochloric acid.

In cases where it is not desired to examine for sulphates, a mixture of nitre with gunpowder may be very advantageously substituted for the nitre and charcoal. The mixture being more powerful, allows the use of a larger proportion of carbonate of soda, thus ensuring more complete decomposition. One part by weight of the insoluble substance may be mixed with four parts of carbonate of soda, four parts of nitre, and ten parts of finely powdered gunpowder.

I have examined all the above-mentioned substances by this process also with equally satisfactory results.—*Journal of the Chemical Society*, August, 1865.

EXAMINING BOARDS.

UNIVERSITY OF LONDON.

Examiners in Chemistry.—Dr. Debus; Professor Williamson, University College.

The University of London is not an educating body; it simply grants degrees. A knowledge of Chemistry is necessary for the Matriculation Examination.

Heat—its sources. Expansion. Thermometers—relations between different Scales in common use. Difference between Temperature and Quantity of Heat. Specific and latent heat. Calorimeters. Liquefaction. Ebullition. Evaporation. Conduction. Convection. Radiation.

Chemistry of the Non-Metallic Elements, including their compounds as enumerated below—their chief physical and chemical characters—their preparation, and their characteristic tests.

Oxygen, Hydrogen, Carbon, Nitrogen, Chlorine, Bromine, Iodine, Fluorine, Sulphur, Phosphorus, Silicon.

Combining proportions by weight and by volume. General nature of Acids, Bases, and Salts. Symbols and Nomenclature.

The Atmosphere—its constitution; effects of Animal and Vegetable life upon its composition.

Combustion. Structure and properties of Flame. Nature and composition of ordinary Fuel.

Water—Chemical peculiarities of natural waters, such as rain-water, river-water, spring-water, sea-water.

Carbonic Acid. Oxides and Acids of Nitrogen. Ammonia. Olefiant Gas, Marsh Gas. Sulphurous and Sulphuric Acids. Sulphuretted Hydrogen.

Hydrochloric Acid. Phosphoric Acid and Phosphuretted Hydrogen. Silica.

In the Examination for Honours, the Candidate, not more than twenty years of age, who shall most distinguish himself in Chemistry will receive a Prize to the value of Ten Pounds in money or books.

DEGREE OF BACHELOR OF SCIENCE (B.SC.).

This recently-instituted Degree is conferred on Candidates who pass a satisfactory Examination in Mathematics, Mechanical and Natural Philosophy, Zoology, Animal Physiology, Geology and Palæontology, and Chemistry.

For the first examination of the Candidate, a knowledge of Inorganic Chemistry only is necessary, including the following subjects:—

Matter; simple and compound.

Elementary bodies classed. Metallic and Non-Metallic bodies.

Chemical combination and Mechanical mixture. Solution.

Outlines of Crystallography. Isomorphism. Dimorphism. Allotropic conditions of matter. Chemical Affinity. Laws of Combination by weight and by volume, as deduced from the history of the individual elements. Equivalent numbers. Equivalent volumes. Symbolical notation. Formulæ. Nomenclature.

Chemical actions produced under the influence of Heat. Nature of Combustion. Structure and properties of Flame. Principles of Illumination. Chemical action of Light. Photography.

Oxygen. Ozone.

Hydrogen. Water.

Nitrogen. Chemical constitution of the Atmosphere. Diffusion of Gases. The Oxides of Nitrogen. Nitric Acid. Ammonia.

Chlorine, Bromine, and Iodine. Their compounds with Oxygen and Hydrogen. Theory of Bleaching.

Fluorine and Hydrofluoric Acid.

Sulphur. Sulphurous Acid. Manufacture and Chemical applications of Sulphuric Acid. Other Oxygen compounds of Sulphur. Sulphuretted Hydrogen.

Phosphorus. Oxygen and Hydrogen compounds of

[‡] This method of treating insoluble substances was originally suggested by Mr. Hadow's process for extracting the silver from old photographic baths by deflagrating the precipitated chloride with saltpetre and wood.

Phosphorus. Theory of Acids. Monobasic, Bibasic, and Tribasic Acids.

Carbon. Carbonic Oxide and Carbonic Acid. The principal Hydrogen Compounds of Carbon. Manufacture of Coal-gas.

Silicon and Boron. Their compounds with the elements previously enumerated.

Metals. Characters of Metals as a Class. Metallurgical Processes. Alloys. Classification of the Metals.

Potassium. Nitre; Gunpowder. Theory of the action of Gunpowder.

Sodium. Manufacture of Carbonate of Soda.

Barium. Strontium. Calcium. Mortars. Cements.

Magnesium. Aluminium. Glass. Porcelain.

Manganese. Iron. Composition and properties of cast iron, wrought iron, and steel. Chromium. Cobalt. Nickel. Zinc. Cadmium. Lead. Manufacture of white lead.

Copper. Mercury. Bismuth. Tin. Arsenic. Antimony. Silver. Gold. Platinum.

Principal compounds of the metals with the Non-Metallic elements. Theory of salts.

Principles of Mineral Analysis.

Principles of Electro-Chemistry.

In the Examination for Honours, the Candidate, not more than twenty-two years of age, who shall most distinguish himself in Chemistry and Natural Philosophy shall receive an Exhibition of Forty pounds per annum for the next two years.

SECOND EXAMINATION FOR B.SC. DEGREE.

This Examination embraces Organic Chemistry, including the following subjects:—

Ultimate analysis of Organic bodies. Calculation of empirical formulæ. Methods of controlling empirical formulæ, Determination of the equivalents of organic acids and bases; examination of products of decomposition; determination of the vapour density of volatile bodies.

Law of substitution. Compound radicals. Homologous series.

The Chemical history of the Cyanogen group. Cyanogen. Hydrocyanic acid. Cyanic acid and Urea. Fulminates. Cyanuric acid. Sulphocyanic acid. Chlorides of Cyanogen. Uric acid.

Amylaceous and saccharine substances. Fermentation. Alcohol, wine, beer, bread, &c.

Homologues of Alcohol. Ethers, simple and mixed. Oxidation of Alcohol. Aldehyde and Acetic acid and their homologues. Anhydrides, simple and mixed. Compound ethers.

Diatomic Alcohols and their acids. Glycol and Oxalic acid and their homologues.

Triatomic Alcohols. Glycerine. Fatty and oily bodies. Saponification.

Vegetable acids. The principal.

Ammonia and its derivatives. Ammonium and Ammoniacal salts. Amides and Amines: their classification. The chief natural Organic Bases.

Colouring matters. Indigo and its derivatives. Principles of Dyeing.

The chief constituents of the Vegetable organism. Cellulose, Vegetable fibrin, Albumin, Casein, Glutin, &c.

The chief constituents of the Animal organism. Animal fibrin, Albumin, Casein, Gelatin. Blood, Milk, Bile, Urine, &c.

Decay, putrefaction. Destructive distillation.

The Chemical principles of the process of Nutrition and of Respiration in Plants and Animals.

The Candidate, not more than twenty years of age, who, in the Examination for Honours, shall most distinguish himself in Chemistry and Biology, will receive Fifty pounds per annum for the next two years, with the title of University Scholar.

EXAMINATIONS IN CONNEXION WITH THE DEPARTMENT OF SCIENCE AND ART, SOUTH KENSINGTON.

A sum of money is voted annually by Parliament for scientific instruction in the United Kingdom.

This sum is administered by the Science and Art Department.

The object of the grant is to promote instruction in Science, especially among the industrial classes, by affording a limited and partial aid or stimulus towards the founding and maintenance of Science schools and classes.

The following are among the Sciences towards instruction in which aid is given:—Acoustics, Light, Heat, Magnetism, and Electricity. Inorganic Chemistry. Organic Chemistry. Geology. Mineralogy. Mining. Metallurgy.

The assistance granted by the Science and Art Department is in the form of—1. Payments on results to certificated teachers. 2. Grants towards the purchase of apparatus, &c. 3. Public examinations, in which Queen's Medals, Honorary Certificates, and Prizes are awarded, held at all places complying with certain conditions. On the results of these examinations the payment on results is made to the teachers.

Examinations for Certificates to teach any of the before-mentioned Sciences are held annually, commencing in the first week in November, at South Kensington. Examinations will also be held in Dublin and Edinburgh if five candidates register themselves for examination in Ireland and in Scotland. Any person whatever may attend this examination by sending in his name to the Secretary of the Science and Art Department before October 15, stating the subject or subjects in which he wishes to be examined. Certificates of three grades are given in each group and each subject. These certificates are only considered as simple records of the results of examination in the various sciences before mentioned, entitling the teacher to earn payments by successful teaching in the subjects for which he is certificated.

The Science and Art Department holds, through the agency of each Local Committee, in May of each year, a public examination of all Science schools and classes in any locality throughout the United Kingdom which complies with the requisite conditions. On the results of this examination the payments are made to certificated teachers. Application for it must be made to the Secretary of the Science and Art Department before the end of March in each year, stating the number of persons and the subject or subjects in which they are to be examined. All registered students of Science classes under certificated teachers (except Science certificated teachers) are eligible to receive Queen's prizes and Queen's medals under the conditions hereafter mentioned.

The results of the May examination are classified under the following heads:—(1) first class, (2) second class, (3) third class, (4) honourable mention, (5) pass, and (6) failed. The names of the successful candidates, those under the first five heads, are published. The standard of attainment required may be raised from year to year. For the pass it is only such as will justify the examiner in reporting that the instruction has been sound, and that the students have benefited by it. Those who have obtained a higher degree of proficiency are classed as honourable mention, or as 3rd, 2nd, or 1st class, according to their merit.

To the 1st class are given Queen's prizes, consisting of books chosen by the candidates from lists furnished for that purpose. These prizes are unlimited in number, except that a student who has once received a 1st class Queen's prize cannot receive a prize in the same subject again. If such student should be again successful, his name will simply be recorded in the published list. To the 2nd and 3rd class certificates of merit recording the result of the examination are given.

The Queen's medals are, one gold in each group, one silver and two bronze in each subject, for competition throughout the United Kingdom. Only registered students of schools and classes under local committees can obtain medals. They cannot be taken by middle class students who are more than 17 years of age.

The payments to the certificated teacher are as follows:—He receives 1*l*. for every student of the industrial classes who has received forty lessons from him in a subject in which he is certificated, and passes in such subject of scientific instruction; 2*l*. for every one who is honourably mentioned; 3*l*., 4*l*., or 5*l*. for every one who takes a 3rd, 2nd, or 1st class. These students must have received forty lessons at least from the teacher since the last examination at which payment was claimed on their account. The forty lessons need not necessarily be all given in one year, but may extend over a longer period. 5*l*. is the maximum that can ever be claimed on account of the instruction of any one pupil in a subject.

A grant towards the purchase of apparatus, diagrams, &c., of 50 per cent. on the cost of them, is made to Science schools and classes in Mechanics' and similar institutions where the teacher is certificated, and to the extent of 5*l*. to other poor schools and classes.

The travelling expenses (second class railway fare and 10s. per diem personal allowance) of a candidate in attending the November examination are paid if he be successful in taking a certificate or in improving the grade of one he has already taken.

CHEMICAL LECTURES.

ROYAL SCHOOL OF MINES AND COLLEGE OF CHEMISTRY.

Chemistry.—Professor E. Frankland, F.R.S., P.D.

The instruction in Chemical Science embraces—

1. A Course of Lectures on Experimental Chemistry, with special reference to the applications of Chemistry in the Arts and Manufactures.

2. A systematic Laboratory Course for the Practice of Chemical Analysis.

The Lectures are delivered in the Theatre of the Royal College of Chemistry, Oxford Street.

Chemical Laboratory.—The general Laboratory for instruction in chemical manipulation, in qualitative and quantitative analysis, and in the method of performing chemical researches, is under the direction of Dr. Frankland. The Royal College of Chemistry having become the property of the Government, its spacious and well-furnished Laboratories are used for the instruction of the pupils of the Royal School of Mines.

There are three terms in the collegiate year, of three months each. The Laboratory hours are from 10 a.m. to 5 p.m., with the exception of Saturdays, when the Laboratory closes at 2 o'clock.

Each Laboratory student works independently, there being no classes. All operations are superintended by the Professor and his Assistants. A table with drawers, cupboards, and shelves, is appropriated to every pupil. The Institution supplies gas, fuel, and reagents. The larger and more expensive instruments of the Laboratory, such as air pumps, thermometers, barometers, condensers, &c., may be used by the students, who are held responsible for their safety. The students have to provide themselves only with the apparatus specified in the Laboratory regulations. More advanced students engaged in private researches have to supply themselves with such materials as are not included amongst the ordinary reagents of the Laboratory.

The charge for instruction in the Chemical Laboratory is 12*l*. for three months, 9*l*. for two months, and 5*l*. for one month.

Metallurgy.—Professor: Dr. Percy, F.R.S.

The course of instruction in Metallurgy consists of Lectures and Laboratory practice.

In the Lectures the processes of extracting metals from their ores are fully described, the chemical principles which they involve are explained, a detailed description is given of the furnaces and machinery employed, and, as far as reliable information can be obtained, the cost of production is stated. The illustrations consist of a very extensive series of specimens, diagrams, and models. Experimental demonstrations are occasionally introduced, but the time required for the satisfactory illustration by experiment of the chemical phenomena which occur in metallurgical processes is generally so long as to make it impossible that in this respect the Lecturer of Metallurgy should follow the example of the Lecturer on Chemistry. In the Metallurgical Laboratory the students have the opportunity of conducting all necessary experimental investigations.

Metallurgical Laboratory.—This Laboratory is conducted by Mr. R. Smith, under the direction of Dr. Percy, and is devoted to practical instruction in Metallurgy. The instruction comprises assaying in all its branches, especially of the more important metals, such as iron, copper, lead, tin, alloys of silver and gold, &c., and the examination of ores and metallurgical products.

There are three terms in the collegiate year, of three months each. The Laboratory hours are from 10 to 4 during November, December, January, and February; and from 10 to 5 during the other months, with the exception of Saturdays, when the Laboratory is closed.

The charge for instruction in the Metallurgical Laboratory is 15*l*. for three months, 12*l*. for two months, and 7*l*. for one month.

Lectures to Working Men.—Short Courses of Lectures at suitable periods of the year are given in the evening to Working Men. These courses are systematic, and arranged so as illustrate, within the period of two years, the principal subjects taught at the Institution. Those for the ensuing Session include Chemistry, Metallurgy, Physics.

UNIVERSITY COLLEGE.

Chemistry.—Professor Williamson, Ph.D., F.R.S.

Daily, except Saturday, from 11 to 12.

Payment to the College, for a Half Term, 3*l*.; for the Term, 6*l*.; Perpetual, 9*l*.

The properties of the more important elements, and the methods of detecting and separating them, will be explained.

Processes for preparing chemical compounds useful in Medicine or the manufacturing Arts will be examined in connexion with the principles upon which they depend. The construction and use of apparatus for experimental purposes will be shown.

The Subjects of the Course will be considered in the following order:—

Changes in the condition of matter by the action of heat.

Light in its bearings upon chemical action, and in its application to analysis.

Electricity as an agent of decomposition and change.

The atmosphere in its chemical and physical properties, and its functions in supporting vegetable and animal life. Explanation of the processes of eudiometric analysis, and demonstration of the regularity of combining volumes of gases.

The non-metallic elements, such as sulphur, iodine, &c., and the simplest of their compounds, as sulphuric acid, nitric acid, ammonia, &c.

The metals, and the most useful or remarkable of their compounds, in connexion with the laws of combination; also the constitution of salts, the atomic theory, &c. The tests for poisons will be explained and shown.

About thirty to forty Lectures will be devoted to Organic Chemistry, including the characteristic properties and metamorphoses of the chief groups of organic compounds, whether of animal or vegetable origin, such as the alcohols, fatty acids, alkaloids, acids of the bile, albuminous substances, &c.

Practical Chemistry.—Professor Williamson, Ph.D., F.R.S.

The Professor is aided in the direction of the Students by Assistants.

INSTRUCTION IN ANALYTICAL CHEMISTRY.

Birkbeck Laboratory.

The Course of Instruction in this department is intended for the assistance of Senior Students in the pursuit of all branches of Chemical Investigation, more especially Organic Research, and for the instruction of less advanced pupils in Elementary Analysis. It qualifies the Student for the application of Chemical Science to Agriculture, Medicine, and the Mechanical Arts; and arrangements have been made for giving practical instruction in Gas Analysis. The Laboratory and offices are fitted up completely with the most approved apparatus and utensils for experimental research, both for beginners and advanced Students. They are open daily from 9 a.m. to 4 p.m. from October 3 until the end of July, with a short recess at Christmas and Easter.

Fee for the Session, 26*l.* 5s.; six months, 18*l.* 18s.; three months, 10*l.* 10s.; one month, 4*l.* 4s., exclusive of the expense of materials. A deduction of 40 per cent. is made for Students who can attend only three fixed days per week.

The Gold Medal as a reward of merit for this Class will be given by the Council as usual.

ELEMENTARY CLASSES OF PRACTICAL CHEMISTRY.

Summer Course.—A Course of Fifty Lessons, of one hour each, on Mondays, Tuesdays, Wednesdays, Thursdays, and Fridays, from 11 to 12, commencing the first week in May.

Fee 4*l.* This payment includes the cost of materials, &c.

Elementary Chemistry—Theoretical and Practical.

Birkbeck Course.

Professor Williamson, F.R.S., and Dr. Russell.

A Course of Fifteen Lessons, of two hours each, on Tuesday and Friday, from the beginning of May to the end of June. Hours, from 7 to 9 p.m. Fee, including the cost of materials, &c., 2*l.*, for Masters of Unendowed Schools and Ushers, and for persons engaged in Manufactures or like pursuits.

The elements of Chemistry are explained to the Class, and the experiments illustrating the subject performed by the Students.

The first part of the Course is devoted to the study of non-metallic elements and compounds, their properties, and the best methods of distinguishing and separating them. In the second part the most important properties of the metals are studied. The ordinary methods of inorganic analysis are especially dwelt on, and solutions frequently given to the Class for analysis.

All the experiments and analyses are repeated by each Student, or by not more than two Students jointly.

KING'S COLLEGE.

Professor of Chemistry.—W. A. Miller, M.D., F.R.S.

Professor of Practical Chemistry.—C. L. Bloxam, Esq.

Demonstrator.—E. A. Hadow, Esq.

The course commences with a View of the Forces which concur to the production of Chemical Phenomena, after which the laws of Chemical Attraction are discussed, and the Non-metallic Elements and their principal Compounds are described.

The metals and their principal compounds are next examined, care being taken to point out the applications of the Science to the Arts, and the processes of the different Manufactures, of Metallurgy, and of Domestic Economy, are explained and illustrated.

Examinations of the Class, both *vivâ voce* and by written papers, are held at intervals during the course of the usual Lecture hour. Dr. Miller has published a work on Chemistry, which is used as a text-book by the Class.

Third Year.—Students who have completed six Terms in this department are admitted to a Course of "Practical Chemistry," consisting of twelve Demonstrations in each term; and they go through a course of Manipulation in the most important operations of Chemistry, including the first steps of Analysis.

Any Student of this department may be admitted to this Class at any period of his study on payment of an extra fee.

Experimental and Analytical Chemistry in the Laboratory.—The object of this Class is to afford to Students who are desirous of acquiring a knowledge of analysis, or of prosecuting original research, an opportunity of doing so under the superintendence of the Professor and Demonstrator; Students may enter, upon payment of the extra fees, at any time except during the vacation, and for a period of one, three, six, or nine months, as may best suit their convenience. The Laboratory hours are from ten till four daily, except Saturday, on which day the hours are from ten till one.

In addition to the Laboratory Fee, each Student defrays the expenses of his own experiments. The amount of this expense, which is comparatively trifling, is entirely under his own control.

EVENING CLASSES.

Classes for Evening Instruction are held at King's College from October to March, and during April, May, and June.

The Classes include one for the Elements of Chemistry and one for Practical Chemistry.

The fee for the former is 1*l.* 11s. 6d.; for the latter 2*l.* 2s. The Classes meet twice a-week.

MINERALOGY.

Professor.—James Tennant, Esq., F.G.S.

The Course commences with a description of the Physical and Chemical characters of Minerals in general. The principal simple Minerals are next separately considered, and the readiest mode of distinguishing them described.

The course of instruction includes a minute description of all the substances entering into the composition of Rocks, and of those minerals which are also used in the Arts; illustrated by an extensive collection of characteristic specimens, and diagrams of the principal crystalline forms, &c.

LECTURES AT LONDON MEDICAL SCHOOLS.

ST. BARTHOLOMEW'S HOSPITAL AND COLLEGE.

WINTER SESSION.

Lecturer.—Dr. Odling, Monday and Friday, at half-past ten, and Wednesday, at ten. One course, 5*l.* 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. Odling, Monday, Tuesday, Thursday, and Friday, from eleven to one. One course, 2*l.* 2s.

CHARING-CROSS HOSPITAL AND COLLEGE.

WINTER SESSION.

Lecturer.—Mr. C. W. Heaton. Tuesday, Thursday, and Saturday at ten. One session, 5*l.* 5s.

The Laboratory is open daily from ten to four p.m.

SUMMER SESSION.

Practical Chemistry.—Mr. Heaton. Monday, Wednesday, and Friday. One session, 2*l.* 2s.

ST. GEORGE'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. H. M. Noad. Tuesday, Thursday, and Saturday, at twelve. One course, 6*l.* 6s.

SUMMER SESSION.

Practical Chemistry.—Dr. Noad. Daily, at half-past nine. One course, 4*l.* 4s. Besides the usual course, instruction is given in the Laboratory daily by Dr. Noad.

GUY'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. A. Taylor. Tuesday, Thursday, and Saturday at eleven. One course, 5*l.* 5s.

SUMMER SESSION.

Practical Chemistry.—Mr. Stevenson. Monday, Wednesday, and Friday, from ten to one. One course, 4*l.* 4s.

LONDON HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. Letheby. Monday, Wednesday, and Friday, at half-past ten. One session, 7*l.* 7s.

SUMMER SESSION.

Practical Chemistry.—Dr. Letheby. Monday, Wednesday, and Friday, at a quarter-past eleven. One session, 2*l.* 2s.

ST. MARY'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. Matthiessen. Tuesday, Thursday, and Saturday, at a quarter-past ten a.m. One session, 5*l.* 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. Matthiessen. Saturday, from nine to one. One session, 3*l.* 3s.

MIDDLESEX HOSPITAL.

WINTER SESSION.

Lecturers.—Mr. Taylor and Mr. Heisch. Monday, Wednesday, Friday, and Saturday, at eleven. One session, 3*l.* 3s.

SUMMER SESSION.

Practical Chemistry.—Mr. Taylor and Mr. Heisch. Monday, Thursday, and Friday, at half-past eleven. One session, 5*l.* 5s.

ST. THOMAS'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. A. J. Bernays. Tuesday, Thursday, and Saturday, at eleven.

SUMMER SESSION.

Practical Chemistry.—Dr. A. J. Bernays. Friday, at twelve; Saturday, ten to one.

WESTMINSTER HOSPITAL.

WINTER SESSION.

Lecturer.—Mr. F. Dupré, Ph.D. Tuesday and Thursday, at three; Friday, at half-past ten. One course, 5*l.* 5s.

SUMMER SESSION.

Practical Chemistry.—Mr. F. Dupré. Tuesday and Thursday, at half-past nine. One course, 2*l.* 2s.

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, 17, BLOOMSBURY SQUARE, W.C.

LECTURES ON CHEMISTRY AND PHARMACY BY DR. REDWOOD.

These Lectures will be delivered on Wednesday and Friday mornings, at half-past 8 o'clock.

Part 1.—Physics in relation to Chemistry and Pharmacy.
Part 2.—Chemistry of Inorganic Bodies.
Part 3.—Chemistry of Organic Bodies.

Fee.—For Registered Apprentices and Associates of the Society, 10s. 6d. For those not connected with the Society, 1*l.* 1s.

Students have free admission to the Library and Museum.

Laboratory.—The suite of Laboratories for Practical Instruction in General and Pharmaceutical Chemistry is under the direction of Dr. Attfield, assisted by Mr. Tilden. Fee for the entire session of ten months, 26*l.* 5s. The Laboratories are open from half-past 9 a.m. till 5 p.m. Students can enter at any period during the Session.

Two Jacob Bell Memorial Scholarships of 30*l.* each are open to competition annually in July.

CITY OF LONDON COLLEGE, LEADENHALL STREET.

An Evening Class on Monday, at 7 p.m., for Experimental instruction in Theoretic Chemistry. The annual Course consists of three terms, each averaging ten lectures; fee, 5s. per term. Subjects: First year, Metalloids; second year, Metals and Practical Analysis.

ROYAL VETERINARY COLLEGE, CAMDEN TOWN.

Chemical Professor.—Richard V. Tuson.

The Session commences October 3 and ends May 1.

Lectures on Chemistry and Veterinary Materia Medica on Monday, Wednesday, and Friday mornings, from eleven till twelve.

Practical Chemistry in the new Laboratory daily.

THE ALBERT VETERINARY COLLEGE, QUEEN'S ROAD, BAYSWATER.

Chemical Professor.—W. J. Russell, Ph.D., F.C.S.

PRIVATE TEACHERS OF CHEMISTRY IN LONDON.

Mr. J. C. Braithwaite, 54, Kentish Town Road, N.W. —Chemical and Toxicological Class on Monday and Thursday evenings at 8. Laboratory open daily, except Saturdays.

Professor E. V. Gardner, F.C.S.—College of Experimental and Natural Philosophy, 44, Berners Street. Laboratory and Class Rooms open daily, morning and evening.

Evening Classes in connexion with the Department of Science and Art. The chemical lectures embrace courses on—I. Elementary Chemistry. II. Chemistry and Chemical Analysis. III. Organic Chemistry. IV. Geology and Mineralogy. A Laboratory Class also meets on two evenings in each week.

Mr. S. Highley, F.G.S., F.C.S., &c.—Scientific Educational Museum, 18, Green Street, Leicester Square, gives evening class instruction in the following educational courses:—Geology, Mineralogy, chemical and physical. Photography: its principles, practice, and applications, &c., &c.

Mr. Henry Matthews.—Laboratory, 30, Gower Street, Bedford Square, gives practical instruction in Chemistry in its application to Medicine, Agriculture, and Commerce. Laboratory open daily.

Dr. Medlock, 20, Great Marlborough Street, Regent Street.

Messrs. Nesbit, Lansdell, and Co.—College of Chemistry and Agriculture, 38, Lower Kennington Lane, S. Practical and Analytical Chemistry, Mr. J. Lansdell, F.C.S., 10 a.m. to 5 p.m.

Mr. John Newlands, F.C.S.—Laboratory, 19, Great St. Helens, Bishopsgate Street, gives practical instruction in Analysis, and prepares gentlemen for various public examinations.

Polytechnic Institution.—Professor Pepper.—A Course of Lectures on the Chemistry of the Non-Metallic Elements will be given on Monday evenings during the present term.

Wentworth E. Scott, F.C.S.—Analytical Laboratory, Cornwall Villa, Westbourne Park. The Laboratory will re-open for pupils on Monday, October 16.

Mr. A. P. Tarner.—Laboratory, 3, Upper Baker Street, N.W., gives practical instruction in Chemistry in all its branches. The class of instruction is modified to suit the requirements of the student.

UNIVERSITY OF OXFORD.

Professor of Chemistry.—Sir B. C. Brodie, Bart., M.A., F.R.S.

Lee's Reader in Chemistry.—A. G. V. Harcourt, M.A.

A commodious Laboratory is attached to the new museum.

Scholarships of about the value of 75*l.* are obtainable at Christchurch, Magdalen, and other Colleges, by competitive examination in Natural Science.

UNIVERSITY OF CAMBRIDGE.

Professor of Chemistry.—G. D. Liveing, M.A.

A Course of Lectures is delivered every Lent and Easter Term. The former course must be attended by candidates for the B.A. and LL.B. degrees. Candidates for Medical degrees must attend both courses.

There is no University Laboratory, but Sydney and St. John's Colleges have laboratories of their own. The latter is open to members of other Colleges when not fully occupied by its own.

A new and commodious laboratory, in connexion with Downing College, will shortly be ready for use.

PROVINCIAL SCHOOLS.

BIRMINGHAM.—QUEEN'S COLLEGE.

Professor of Chemistry.—Alfred Anderson.

A course of seventy Lectures on General Chemistry during the Winter Session, and a Practical Course for the Medical Boards in the Summer.

The Laboratory is open for daily instruction.

BIRMINGHAM.—SYDENHAM COLLEGE.

Professor of Chemistry.—Dr. A. Hill.

A Course of Lectures on General Chemistry during the Winter Session, and a Practical Course in the Summer.

The Laboratory is open for daily instruction.

BIRMINGHAM.—MIDLAND INSTITUTE.

Lecturer on Chemistry.—Mr. W. M. Williams.

BRISTOL.—BRISTOL MEDICAL SCHOOL.

Lecturer on Chemistry.—Mr. Herapath.

BRISTOL SCHOOL OF CHEMISTRY.

Conducted by Dr. F. W. Griffin.

A Course of Lectures on General Chemistry, commencing in October, and Laboratory instruction throughout the year.

ROYAL AGRICULTURAL COLLEGE, CIRENCESTER, GLOUCESTERSHIRE.

Professor of Chemistry.—A. H. Church, M.A., Oxon, F.C.S.

Assistant Professor of Chemistry.—R. Warington, Esq., jun., F.C.S.

The Session commences on August 3. The Courses on Organic and Organic Chemistry will be continued to the end of the Session. The Lectures are illustrated by experiments and specimens. Some stress is laid upon the knowledge of important minerals, of which, in the College Museum, there is a good collection, lately enriched by valuable additions presented by Capt. Guise.

The lectures are given at the following hours:—

Inorganic Chemistry.—Tuesday, 2 p.m.; Thursday (catechetical), 10 am.; Friday, 9 a.m.

Organic Chemistry.—Thursday, 3 p.m.; Friday, 2 p.m.

The Course of Instruction in Practical Chemistry in the Laboratory comprises Chemical Manipulation for the 1st Class, Qualitative Analysis for the 2nd, and Quantitative Analysis for the 3rd. The book used in these Classes is "Church's Laboratory Guide for Students of Agricultural Chemistry" (Van Voorst). Examples for the 3rd Class are selected from Agricultural Products and Materials. Students of the 4th Class who are desirous of obtaining the College Diploma work in the Professor's private laboratory.

Chemical Manipulation.—Monday, 2 p.m.; Wednesday, 9 a.m.

Qualitative Analysis.—Tuesday, 10 a.m.; Thursday, 11 a.m.

Quantitative Analysis.—Thursday, 2 p.m.; Friday, 2 p.m.

The Autumn Session of the College divides October 6. The Spring Session will commence about January 8, 1866.

HULL AND EAST RIDING SCHOOL OF MEDICINE.

Lecturer on Chemistry.—Mr. Walton.

The usual Courses for the Medical Boards.

LEEDS SCHOOL OF MEDICINE.

Lecturers on Chemistry.—Messrs. Scattergood and R. Reynolds.

The usual Courses for the Medical Boards.

LEEDS MECHANICS' INSTITUTION AND LITERARY SOCIETY'S LABORATORY.

Chemical Classes for instruction in Elementary, Practical, and Analytical Chemistry.

Teacher.—Mr. George Ward, F.C.S.

The usual Sessional Course of instruction in abstract and applied Chemistry will commence on Friday, September 29, at 8 p.m.

The Elementary Class meets on Friday Evenings, 8.15 to 10.

A Class for the study of Organic Chemistry meets on Monday evenings, 8.15 to 9.30.

Practical Chemistry, Laboratory Caurse, Tuesday and Thursday evenings, from 7.30 to 10 o'clock.

Fees, payable in advance:—Elementary Chemistry, Friday, per Session, 1*l.* 15s.; 5s. 6d. per month. The subscription includes a selection of apparatus and material specially adapted for the course of instruction. To pupils providing their own materials, 1*l.* 1s. per Session. Organic Chemistry, Monday, per Session, 10s. 6d. Practical Chemistry, Thursday, per Session, 1*l.* 1s.; 3s. per month. Including apparatus and material.

LIVERPOOL COLLEGE OF CHEMISTRY.

Principal.—Dr. Sheridan Muspratt.

Assistant.—Mr. M. Murphy.

Laboratory open daily, except Saturdays. The principal or his assistant is always present from 10 to 5.

A Course of Practical Chemistry for Medical Students in the Summer.

LIVERPOOL ROYAL INFIRMARY SCHOOL OF MEDICINE.

Lecturer on Chemistry.—Dr. J. B. Edwards.

The usual Courses for the Medical Boards.

MANCHESTER ROYAL SCHOOL OF MEDICINE.

Lecturer on Chemistry.—Mr. D. Stone.

The usual Courses for the Medical Boards.

A Laboratory is connected with the School.

OWEN'S COLLEGE, MANCHESTER.

(IN CONNEXION WITH THE UNIVERSITY OF LONDON.)

Chemistry.—Professor H. E. Roscoe, B.A., Ph.D., F.R.S., F.C.S.

Junior Class.—Wednesday and Saturday, from 9·15 to 10·15 a.m.

Subject: Inorganic Chemistry, comprising the laws of chemical combination, and a description of the properties and mode of preparation of the elementary bodies and their most important inorganic compounds. Fee, 3*l.* 3.

Senior Class.—Tuesday and Thursday, from 9·15 to 10·15 a.m.

Subject: Organic Chemistry, giving the properties and relations of the best defined groups of organic bodies, and the laws regulating their formation.

Students are expected to answer the written exercises and attend the *viva voce* examinations given in these classes. Fee 3l. 3s. For both classes, 5l. 5s.

Extra Class.—Wednesday, from 4 to 5 p.m.

Subject: Technological Chemistry.

The chemical principles involved in the most important chemical manufactures will be chiefly considered in this course. The subjects will be discussed as follows, and as far as time will permit:—

1. Production of Heat—Heat of Combustion—Combustibles—Coal.
2. Production of Light—Coal Gas—Measurement of Illuminating Power of Coal Gas—Distillation of Coal.
3. Water and Air, as regards their Sanitary and Technological Relations.
4. Processes concerned in the manufacture and application of the Alkalies.
5. Dyeing and Calico Printing.
6. Manufacture of Acids.
7. Manufacture of Glass and Porcelain.

Students attending this course must be acquainted with the principles of chemical science. Fee, 2l. 2s.

Analytical and Practical Chemistry.—Laboratory Course—Professor Henry E. Roscoe, B.A., Ph.D., F.R.S. (The Professor is assisted in the instruction of the students by Mr. C. Schorlemmer.)

The aim of this course is to make the student practically acquainted with chemical science, to enable him to conduct analysis and original research, and to fit him for applying the science to the higher branches of Art, Manufactures, and Agriculture. To accomplish this, an attendance of not less than four days per week during three whole Sessions is, as a rule, necessary. It is very advisable that each laboratory student should attend or should have attended the course of lectures on Theoretical Chemistry.

The College Laboratory will be open for students daily from 10·30 a.m. until 5 p.m., except on Saturdays, when it will be closed at 1·30. Half an hour, from 1·30 until 2, allowed for dinner.

The Laboratory is fitted with every convenience for the prosecution of practical chemistry, all branches of qualitative and quantitative analysis, and original research. Each student is provided with a separate working table, set of tests, fuel, water, and gas, free of expense; but he is required to provide his own apparatus, a few of the more expensive reagents, and the chemicals required for his experiments. Other apparatus or instruments of a more expensive description may be obtained on loan from the Laboratory Steward, subject to regulations to be prescribed by the Professor.

Fees for the Session.—Students working six days per week, 21l.; ditto four days, 17l. 17s.; ditto three days, 13l. 13s.; ditto two days, 9l. 9s.; ditto one day, 5l. 5s.; Students entering the Laboratory Class at or after Christmas, for not less than two days per week, will be charged two-thirds of the fees for the whole Session.

Special Fees for Shorter Periods.—For six months, six days per week, 17l. 17s.; five months, ditto, 15l. 16s.; four months, ditto, 13l. 13s.; three months, ditto, 10l. 10s.; two months, ditto, 7l. 7s.; one month, ditto, 4l. 4s. Students working only one day per week will ordinarily be required to spend three hours of that time at a class which will be held on Saturday mornings, from 10·30 a.m. to 1·30 p.m.

Chemical Calculations.—Instruction in the methods of Quantitative Estimation in Chemistry, and intended to supplement the instruction in Practical Chemistry, will be given by Mr. Schorlemmer, on Mondays, from 4 to 5 p.m.

Laboratory students are recommended to attend and to answer the written exercises, and the *viva voce* questions given in this class.

Free to all students attending the Laboratory Classes. Fee to others, 1l. 1s.

Dalton Chemical Scholarships.—Two, each of the annual value of 50l., offered in alternate years, and tenable for two years. The scholarships are awarded for the best original investigations in chemistry prosecuted at the College, with a satisfactory written examination in Chemistry.

The Lectures on Chemistry in Owen's College are recognised by the University of London for its Medical Degrees, by the Royal College of Surgeons, and by the Apothecaries' Hall.

NEWCASTLE SCHOOL OF MEDICINE.

(IN CONNEXION WITH THE UNIVERSITY OF DURHAM.)

Lecturers on Chemistry.—Dr. T. Richardson and Mr. A. F. Marreco.

The Laboratories are open daily throughout the year from 10 to 5 o'clock. Non-Medical students can attend Laboratory Practice, and receive instruction in analysis, on the following terms—viz., six days in the week, 31l. 10s. per annum; four days in the week, 21l. per annum; and for shorter periods by arrangement. It is recommended that, if practicable, the Winter Course of Lectures should be attended before the student enters the Laboratories.

SHEFFIELD MEDICAL INSTITUTION.

Lecturer on Chemistry.—James Allan, P.D., F.C.S.

The usual Courses for the Medical Boards.

SHEFFIELD SCHOOL OF METALLURGY, CHEMISTRY, AND PHARMACY.

Professor of Chemistry.—James Allan, Ph.D., F.C.S.

The Winter Course of Lectures on Chemistry will commence on Wednesday, October 6, 1865.

The Laboratories for Practical Chemistry and Assaying are open daily.

Evening Classes on Mondays and Thursdays.

SCOTLAND.

The Scottish Schools open on November 6.

UNIVERSITY OF EDINBURGH.

Professor of Chemistry.—Dr. Lyon Playfair, C.B., F.R.S.

ROYAL COLLEGES OF PHYSICIANS AND SURGEONS, EDINBURGH.

The following Courses of Lectures in connection with these Colleges are delivered:—

Chemistry (School of Arts, Adam Square), 10 a.m., Dr. Stevenson Macadam; Practical Chemistry and Analytical Chemistry, 9 a.m. till 5 p.m., Dr. Stevenson Macadam (at Surgeons' Hall); Chemistry (4, High School Yards), 11 a.m., Dr. A. C. Brown; Practical Chemistry and Analytical Chemistry, 9 a.m. till 5 p.m., Dr. A. C. Brown (4, High School Yards).

Practical Chemistry, 3l. 3s.; Analytical Chemistry, 2l. a month, 5l. for three months, or 10l. for the Session of six months.

Practical and Analytical Chemistry, Dr. Stevenson Macadam (at Surgeons' Hall); Practical and Analytical Chemistry, Dr. A. C. Brown (4, High School Yards).

EDINBURGH VETERINARY COLLEGE.

Chemistry, Theoretical and Descriptive.—Dr. A. Dalzell.

UNIVERSITY OF GLASGOW.

Professor of Chemistry.—Thomas Anderson, M.D., F.R.S.E., F.C.S., &c.

Assistants.—Edmund J. Mills, B.Sc., F.C.S., tutor; Magnus M. Tait, F.C.S.; William A. Dixon, F.C.S.; Walter Stewart.

The Courses of Chemical Instruction given by Dr. Anderson are intended to afford to the Student the means of acquiring a thorough knowledge of the Science of Chemistry, and its applications to Medicine and the different branches of the useful arts.

In addition to the Lectures, the class is divided into small sections, which meet separately, and receive tutorial instruction from Mr. Mills.

At certain periods during the Course, written exercises are prescribed, some to be done at home, and others in the lecture-room, and without the aid of books or notes.

The Course of Practical Instruction in the Laboratory is arranged in such a manner as to lead the Student through a complete series of Analytical operations.

The fundamental instructions are the same for every pupil, whatever may be the ultimate object of his studies; but after he has acquired a competent knowledge of the general methods of analysis, and a sufficient amount of practical skill, the course for each student diverges into the particular department of the science, or its practical application to Medicine, Agriculture, or the Manufacturing Arts, which he may desire to prosecute.

Students can enter the Laboratory at any time throughout the year.

The Laboratory Fee is 4*l.* 4s. for three months; for the Course of Lectures, 3*l.* 3s.

ANDERSON'S UNIVERSITY, GLASGOW.

Professor of Chemistry.—Dr. Penny.

The Winter Course of Scientific Lectures on Chemistry will be commenced on Tuesday, November 1, at 10 a.m.

Instruction in Practical Chemistry and Analysis in the Laboratory, daily from 11 till 4.

The Private Laboratory for Commercial Analyses and Assays is open daily throughout the year.

Evening Course of Popular Lectures on Inorganic Chemistry, with special reference to the Industrial Arts, on Fridays, commencing November 6, at 8·30.

Evening Course of Practical Chemistry, on Thursdays, at 7.

GLASGOW MECHANICS' INSTITUTION.

Lecturer on Chemistry.—Dr. Wallace, F.R.S.E., F.C.S.

The Laboratory is open throughout the year for instruction in Practical and Analytical Chemistry. Fee for six months, 10*l.* 10s.

A Course of twenty-five Evening Lectures on Organic Chemistry will commence on 3rd October, at 8·30 p.m.

LABORATORY AND LECTURE-ROOM,
108, INGRAM-STREET, GLASGOW.

A. T. Machattie, Ph.D. F.C.S.

Daily Lectures on Chemistry. — Six months' Course. Fee, 1*l.* 1s. Beginning on Monday, November 6, at 10 a.m.

Analytical Chemistry.—Daily from 9 a.m. till 5 p.m., beginning November 1.

These Classes qualify for the various Medical and Public Boards.

Evening Classes.—Course of twenty-five lectures on Inorganic Chemistry in the Lecture-hall of the Glasgow Athenæum, on Tuesday Evenings at 8, beginning on November 7. The Laboratory is open on Mondays, Wednesdays, and Fridays, from 7 till 9 p.m., for instruction in Analytical and Practical Chemistry.

EVENING SCIENCE CLASSES.
CARLTON-PLACE SECULAR SCHOOL, GLASGOW.

Teacher.—John Mayer, F.C.S.

Chemistry and Metallurgy, especially with the view of passing the Examinations of the Society of Arts and the Government Department of Science and Art.

Lectures on Tuesday and Thursday at 8 p.m.

UNIVERSITY OF ABERDEEN.

Professor of Chemistry.—James S. Brazier, F.C.S.

Teaching Assistant.—James C. Brown.

I. Systematic Course.—The Lectures are delivered on the first five days of each week during the College Session. They commence with the discussion of the General Principles of Chemical Philosophy, including the Atomic Theory and the Chemical Relations of Heat. The Non-metallic and Metallic Elements and their compounds are fully treated of, together with their more important applications to the Arts. The latter part of the course is devoted to the subject of Organic Chemistry.

Oral Examinations are held at fixed periods during the Session.

The Fee is 3*l.* 3s.

II. Practical Course.—This course is given during the Summer Session. It is chiefly devoted to practice in Qualitative Analysis, with the view of enabling the Student to test unknown substances, poisons, the animal secretions, &c.

The Fee is 3*l.* 3s.

III. Laboratory Pupils.—The Chemical Laboratory is open during the College Session, on the first five days in each week, from 10 a.m. to 3 p.m. The course of instruction is under the direction of the Professor of Chemistry and of the Teaching Assistant.

A limited number of the most distinguished Students attending the Practical Course are admitted, free of charge, as working pupils into the Laboratory.

Text books: Wilson's "Chemistry" (Chambers' Course); Fownes' "Manual of Chemistry;" Miller's "Elements of Chemistry."

ST. ANDREWS.

Chemistry.—M. Foster Heddle, M.D.

IRELAND.

DUBLIN.—TRINITY COLLEGE.

Professor of Chemistry.—Dr. J. Apjohn.

The Laboratory is open through the year.

CATHOLIC UNIVERSITY.

Professor of Chemistry.—Dr. W. K. Sullivan.

CARMICHAEL SCHOOL OF MEDICINE.

Lecturer on Chemistry.—Dr. Davy.

Practical Chemistry in the summer.

LEDWICH SCHOOL OF MEDICINE.

Lecturer on Chemistry.—Dr. Cameron.

Practical Chemistry in the summer.

ROYAL COLLEGE OF SURGEONS.

Lecturer on Chemistry.—Dr. Barker.

Laboratory open throughout the year.

QUEEN'S COLLEGE, BELFAST.

Professor of Chemistry.—Dr. Andrews.

QUEEN'S COLLEGE, CORK.

Professor of Chemistry.—Dr. Blyth.

QUEEN'S COLLEGE, GALWAY.

Professor of Chemistry.—Dr. T. H. Rowney.

A Laboratory for practical instruction is attached to all the Queen's Colleges. The usual Practical Course for the Medical Boards is given in the summer. The Winter Session in Ireland commences in November.

NOTICES OF BOOKS.

Journal für Praktische Chemie. No. 10 and 11. 1865.

R. Hermann contributes several papers on the Niobium group of metals. The first and most important is entitled "*Researches on Niobium, Tantalum, and Ilmenium.*" The author announced the discovery of ilmenium in 1845, but its existence has been scarcely recognised, and it is seldom mentioned in chemical works. In this paper, however, a lengthy account of the metal and its compounds is given, which seems to place its individuality beyond doubt, although Blomstrand, experimenting upon one of the same minerals (columbite) in which ilmenium is found, recognised only niobium and tantalum. We shall give an abstract of the paper shortly. The other papers by the same author are "*On the Composition of Wöhlerite, Aeschynite, and Euxenite, with Remarks on Zirconia;*" and "*On the Occurrence of Kerolith in the Ural.*" A paper by Delafontaine "*On the Composition of Molybdates of the Alkalies*" succeeds. The next article is by Rudolph Weber, "*On Compounds of Acichloride of Selenium with*

Metallic Chlorides." The only other paper we need notice is by Dr. Hugo Gericke, "*On the Salts of Bromisatinic Acid, and some Ammonia and Sulphur Derivatives of Bromisatin.*"

CORRESPONDENCE.

Ethers of the Formic Series.

To the Editor of the Chemical News.

Sir,—M. Lorin announced to the French Academy of Sciences last month (August 28) that he had discovered a new method of preparing the formiates of the alcohol radicles. He distils glycerine, oxalic acid, and the requisite alcohol together. Will you permit me to remind your readers that more than nine years ago (in the *Philosophical Magazine* for July, 1856) I described the same process? I may state that the extensions of the process mentioned in my original paper I have repeatedly verified and constantly employed for some years in the preparation of various ethers. I enclose a copy of my original paper.

I am, &c. A. H. Church.

R. A. College, Cirencester.

Manufacture of Soda from Cryolite in America.

To the Editor of the Chemical News.

Sir,—How comes it that the English soda ash manufacturers have allowed the Americans to steal a march on them in the matter of cryolite? A company here have secured, so I understand, the monopoly of all the cryolite mined in Greenland, except that used in Denmark, for the purpose of the manufacture of soda ash. Extensive works are going on up near Pittsburg, in this State. The process used is the Danish—*i.e.*, boiling in lime and precipitating the Al_2O_3 by CO_2. My informant is one of the capitalists of the company.

I think if the cryolite can be obtained in sufficient quantity the importation of soda ash and caustic soda into this country is at an end, or rather will be. I fancied our manufacturers were pretty smart fellows, but they have let the Yankees get ahead of them in this case. All English manufacturers must look well to themselves, as the Americans are following very close at their heels, in some cases tripping them up.

I am, &c. H. B.

Philadelphia, U.S., August 30.

MISCELLANEOUS.

Antozone.—In March last, a paragraph was forwarded to us announcing, with much circumstantiality, the discovery by Schönbein of a means of isolating antozone, and describing some of the properties of the gas. This we published, accompanying it with a remark distinctly intimating our doubts of the truth of the story. After searching in vain in the *Proceedings* of the Munich Academy (to which we were referred) for Schönbein's original paper, we again stated, in the Chemical News for April 7, our disbelief in the story. Unfortunately, a writer on meteorology seems to have seen the first paragraph, and overlooked our reservation; and a few weeks ago he referred to the subject in a letter to *The Times*. This brought a letter from Dr. Roscoe, who, having recently seen Schönbein, learnt from his own lips that no such discovery had been made. *Apropos* to this, our friendly contemporary the *Reader* inserts the following paragraph:—

"According to a letter in *The Times* of Monday last, signed by Professor Roscoe, the story of the supposed decomposition of oxygen, said to have been made by Professor Schoenbein, was simply a *canard* sent to *The Chymical News* some few weeks ago by some wag. Professor Schoenbein, at the recent meeting of Swiss scientific men, at Geneva, expressed himself much amused at the credulity of our countrymen in believing a story for which there is not the slightest foundation. *Antozone, therefore, has no existence.*"

Now as to the *supposed* decomposition of oxygen, or its division into two oppositely active states, we thought that Schönbein had convinced himself, if not everybody else, of the reality of that. Ozone, $\ominus$, we know in the gaseous state; antozone, $\oplus$, has never yet been obtained in the gaseous form; but it would, we fancy, be just as reasonable to deny the existence of fluorine, as to deny the existence of antozone, on the simple ground of its non-isolation. The story told was that Schönbein had *isolated* antozone; and if he is "much amused" at our credulity in believing this, we may say that the Professor himself is to some extent responsible for it,—for, in a letter addressed to Dr. Faraday, published in the *Philosophical Magazine* for February, 1861, he writes:—"I have been working hard these many months to obtain antozone, $\oplus$, in its insulated state, and I flatter myself that I have succeeded—at least, to a certain extent." Now, no great stretch of credulity was required to believe that the Professor had accomplished in 1865 what he says he says he had succeeded in doing, "to a certain extent," in 1861.

British Association.—The following papers were read in Section B on the last day of the meeting:—

T. Wood—On the New Formulæ, with Reference to Schools and Examinations.

Professor Maskelyne—On Crystallised Melaconite and Tenorite.

W. White exhibited Photographs of the Interior of the Great Pyramid taken with the Magnesium Light by Professor C. Piazzi Smyth, with Notes thereon.

W. Willis—On the Aniline Process in Photography.

W. L. Scott—On the Formation of Ammonia from Nitrogen in the Atmosphere.

W. L. Scott—On the Presence and Functions of Ammonia or its Homologues in the Blood.

J. C. Bowring—On the Preservation of the Sheathing of Ships, and Extraction of Silver from Sea Water, by Means of Electricity.

J. C. Bowring—On the Direction of the Electric Current.

A. Hill—On the Sanitary and Economical Aspects of the Sewage Question.

H. Bird—Observations on the Utilisation of Sewage, as conducted at Stroud, and on the Growth of the Sewage Plant.

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. *Private* letters for the Editor must be so marked.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. XI. of the Chemical News, containing a copious Index, is now ready, price 11s. 0d., by post, 11s. 6d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. XII. commenced on July 7, 1865, and will be complete in 26 numbers.

Anxious.—A reply next week.

Thallium.—The observations are new. Will our correspondent send a note for publication?

W. G.—1. Phillips' "Mineralogy," last edition. 2. Bolley and Paul, "Technical Analysis." 3. Of Williams and Norgate, Henrietta Street, Covent Garden.

Microscopical Society.—We are sorry to say that we know of no Society that admits ladies to its ordinary evening meetings.

C. P., Notting-hill.—We shall probably have more of the reports shortly. The Bonn laboratory is expected to be ready in a couple of years. We will endeavour to obtain the terms of the foreign schools

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

*On the Estimation of Nitrites in the Presence of Nitrates,** *by* CHARLES R. C. TICHBORNE, *F.C.S., &c., &c., Chemist to the Apothecaries' Hall of Ireland.*

WHEN I undertook the task of working out the last process for estimating nitrites I thought that the problem would be one of extreme simplicity, and never calculated upon the numerous difficulties with which this project was attended. I have carefully gone through the modes recommended by other experimenters (of which there have not been many), and have also tried numerous original plans. From very few of these have I succeeded in getting accurate results. Of course, I now refer to direct modes of estimating nitrites, more particularly in the presence of nitrates. The difficulties are as follows:

1st. All the processes of estimating nitrites directly must be essentially processes of oxidation, as we are not acquainted at present with any available precipitant.† Therefore arises the difficulty of estimating this compound by oxidation in the presence of a powerful oxidiser—*i.e.*, nitric acid. We have no available precipitant for this latter acid either by which we could dispose of it.

2nd. Another prolific source of error in the estimation of nitrites is one which seems to have been completely overlooked. It is the fact that at the slightest elevation of temperature nitrous anhydride, or nascent nitrous acid, is partially decomposed and oxidised into nitric acid when in the presence of water—that is, at the expense of that substance:—

$$3N_2O_3+H_2O=2HNO_3+4NO.$$

Experiments proving this will be referred to further on.

The process recommended by Peligot, Lang, *Jahresb.*, 1862, p. 581, is not applicable to the examination of nitrites containing nitrates. Also, the long digestion at an elevated temperature (twelve hours at 86° to 104° Fahr.) is inadmissible. Lang says he got results only ·6 per cent. out, but I think he must have worked with pure nitrite of sodium.‡ Feldhaus speaks against this process. In his experiments he seems to have got the results too high; the specimens of nitrite probably contained nitrate. This process seems, in my hands, to give results too low, after the nitrite had been correctly accounted for. The urea process has been unanimously condemned. Lang says it is bad, and Feldhaus also condemns it. As regards my own experiments, they were so unpromising that I did not carry on my examination of this method to any extent, for to attempt to estimate quantitatively free nitrous acid by a boiling solution is evidently radically wrong in principle.§

Estimation by permanganic acid we shall dwell upon at some length, for two reasons: first, because the process has been strongly recommended by authorities; and, secondly, from the fact that, at first sight, this, of all the available oxidising substances, seems the most plausible. Permanganic acid is instantly decomposed, even at 32° Fahr., by nitrous acid; and, from the quickness of the reaction, many plans have been devised to remedy the evils attendant upon this mode of estimation. From the gaseous nature of nitrous acid, it is not desirable to decompose the nitrites first by acids, preparatory to estimating them by a standard solution. To avoid this source of error, Pean de Saint-Gilles has recommended that the nitrite be decomposed by adding very diluted sulphuric or nitric acid. "This prevents a loss of nitrous acid;" but that this is not practically correct is evident from the fact that iodised starch-paper becomes coloured on holding it in the orifice of the flask in which the nitrite is decomposed. Feldhaus says that the salt must be diluted with 2000 parts of water, and the reaction commenced in a very slightly acidulated liquid; when it is nearly completed, more acid may be added if necessary, so as to ensure the marking of the exact point. Lang condemns the process. There can be no doubt that by attention to the instructions given by Feldhaus, and by working at a very low temperature, an approximation may be attained. One of my experiments was to add the nitrite under examination to a known excess of permanganate of potassium, and, as nitric acid was present, to work off the excess by a volumetric solution of oxalic acid. It is, however, impossible to determine the analysis, as, towards the end of the process, a reaction takes place between the permanganic acid added, the manganous oxide resulting in a copious deposit of peroxide of manganese—

$$2HMn_2O_4+3Mn_2O-H_3N=5Mn_2O_2.$$

This reaction seems to take place even more readily in the presence of nitric acid.

I attempted to decompose the nitrite by ignition with oxide of copper, intending to wash the oxide, and, on dissolving it in hydrochloric acid and chloride of sodium, to estimate the amount of cuprous oxide formed volumetrically; but I found, even after prolonged ignition, the nitrite was not decomposed.

The most successful methods are those which I am now about to describe. But I must premise that in all processes of estimating nitrites by oxidation one thing must be borne in mind—that it is imperatively necessary to set free the nitrous anhydride at a low temperature in the presence of an excess of the oxidising material for it must be remembered that nitrous anhydride or nitrous acid, when liberated in the presence of water, is decomposed at slightly elevated temperatures.

The following experiments will illustrate this fact:—If, at an ordinary temperature, a small portion of nitrite of sodium be dropped into diluted sulphuric acid in a test tube, the following reaction will be observed:—The tube will be filled with orange-coloured vapour, whilst a piece of iodised starch paper, held over the orifice, will be slowly coloured. If, on the other hand, the test tube be placed in a freezing mixture, previously to addition of the nitrite of sodium, no orange fumes will be observed, but the colouration of the starch paper is instantaneous, and very decided. In the first instance the nitrous acid was decomposed, as generated, into nitric acid and nitric oxide, the latter being evinced by the orange fumes of pernitric oxide on its coming in contact with the atmosphere. From the foregoing it is evident that to estimate a nitrite by an oxidising reagent, it is better that the

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* Read at the meeting of the Pharmaceutical Conference.

† Nitrite of silver, the most insoluble salt, if we except the cobalt yellows (basic potassio-cobaltic nitrite?), is readily soluble in water, unless the water is at a very low temperature. Whether the cobalt yellow is available for the estimation of nitrites is the subject of some experiments at present unfinished.

‡ A known quantity of dry peroxide of lead is added to a diluted solution of the nitrite to be analysed, and the solution mixed with acetic acid. The whole is warmed for twelve hours—the weight of peroxide dissolved corresponds to the nitrous acid—1 at. peroxide=1 at. nitrous acid

$$(2Pb_2O_2+2HNO_2=Pb_2N_2O_6+Pb_2H_2O_2).$$

§ A standard solution of nitrate of urea is heated to boiling, and the solution of nitrite acidulated, is added drop by drop until the solution produces a blue colouration with starch paste and iodide of potassium. The decomposition is

$$CH_4N_2O+2HNO_2=CO_2+N_4+3H_2O,$$

carbonic anhydride and nitrogen being evolved.

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two be brought together at a temperature sufficiently low, that the oxidiser used may grapple with the nitrous acid previously to a reaction being set up between it and the water. Experiments have been tried to find the reaction of two of the principal oxidisers at a temperature of 32° Fahr. Permanganic acid was instantly decolourised. Chromic acid had no action at 32° Fahr., but on its being placed on one side, so as gradually to attain the temperature of the room, decomposition took place without the evolution of any nitrous oxide.

As stated in a former part of this paper, by a judicious attention to a low temperature, and by a manipulation formed upon Feldhaus's plan, an analysis by permanganate of potassium may be performed, but still inferior in accuracy to the two processes I am now about to describe.

The first process is based upon the reduction of chromic acid to chromic oxide by nitrous acid. This is not so quick as with permanganic acid, but is perfected slowly at ordinary temperatures. Suppose we are analysing a specimen of commercial nitrite of sodium, the mode of procedure I adopt is as follows:—If the sample contains carbonate of sodium, a weighed quantity, say two grammes, is dissolved in a rather considerable quantity of water, and the carbonate estimated by a standard solution of sulphuric acid, carefully avoiding an excess. To hit the exact point of saturation, I soak a piece of good litmus-paper in the solution after the addition of each quantity of acid from the burette, and on drying it the exact state of the solution is perceived. I may here remark that most of the litmus-paper that is bought is not delicate enough for this kind of work, as it generally contains some trace of alkali. A convenient indicator of this point of saturation in this case will be found in a solution of starch and iodide of potassium contained in a test-tube: one drop of the solution of nitrite added after each addition of acid will, when the carbonate is all decomposed, strike a blue shade on falling through the starch solution. After noting the amount of carbonate, the solution is in a fit position for the estimation of the nitrite; the remainder may practically be noted as nitrate. Three grammes of pure bichromate of potassium for every two grammes of nitrite taken are dissolved with a little water in a flask fitted with a well-ground stopper; an excess of sulphuric acid is then added, and the flask is placed in a vessel containing a mixture of sulphate of sodium and hydrochloric acid. The solution of the nitrite may be placed also in the same freezing bath for a few minutes previously to being poured on the surface of the chromic acid without mixing; the stopper is then inserted, the flask taken out of the freezing mixture, inverted, and left to regain the ordinary temperature of the room; in the course of half an hour or an hour the flask will contain a mixture of chromic acid and chromic salt, the chromic oxide representing the nitrite in the sample. But here, again, in precipitating the chromic oxide a precaution is necessary. If there is any considerable excess of chromic acid left, which is generally the case, when examining commercial samples, the ordinary method of precipitating with ammonia would not do, as a brown precipitate of a peroxide of chromium (chromate of chromium?) not decomposable by ammonia is thrown down, although the substance is instantly decomposed, upon boiling, by a solution of potash into chromic oxide and chromic acid. It is therefore necessary to nearly neutralise with potash, and finish off with a few drops of ammonia, and boil until all trace of the latter substance is gone; but if accidentally too much potash is added, a few drops of chloride of ammonium and a boiling for a few minutes will rectify the mistake. If the manipulation has been correctly performed, it will be indicated by the colour. The dark-brown colour instantly disappears on boiling, the precipitate obtaining the bright green of chromic oxide, whilst the solution becomes a bright yellow.

The chromic oxide is washed, but for accurate results the hydrated chromic oxide retains the chloride of potassium too tenaciously to ignite and weigh directly. It is better to re-dissolve the washed hydrated chromic oxide in diluted hydrochloric acid, and to re-precipitate with ammonia in the usual manner. This gives the most exact results; but there are quicker methods. Thus, the hydrated chromic oxide might be washed and converted into chromic acid by Chancel's method (by peroxide of lead) and estimated volumetrically.

Chromic oxide found × 1·354 = nitrite of sodium.

$$\therefore 4Cr_2O_3 + 3N_2O_3 = 3N_2O_5 + 2Cr_4O_3.$$

The second process is based upon the first, that both nitrites and nitrates of the alkalies are converted into chloride, upon ignition with chloride of ammonium.

Pure nitrite of sodium gives 84·78 per cent. of chloride of sodium, whilst nitrate of sodium only gives 68·82. From these data, it is therefore easy to calculate the percentage, as anything under 84·78 indicates the presence of nitrate.

It must be borne in mind that if the specimen contains carbonate, this would give the percentage of nitrite too high. As 100 parts of carbonate would give 110·37 parts of chloride of sodium after ignition, therefore it will be necessary to deduct an equivalent quantity of chloride of sodium from the results before calculating them. A weighed quantity of the nitrite is intimately mixed with powdered chloride of ammonium, and introduced into a platinum crucible; a gentle heat is applied, until the whole of the excess of sal ammoniac and other gaseous bodies are volatilised. The residue is dissolved in water, and the chloride of sodium estimated volumetrically with a silver solution.

After a deduction for any carbonate of sodium present, the calculation may be made thus:—

$$\frac{(NaCl - 68·82) + 100}{15·96} = x,$$

x being the percentage of nitrite of sodium. The chloride of sodium left, minus the percentage of nitrate, divided by the difference (15·96), will give the percentage of nitrite, or *vice versa*:—

$$\frac{(84·78 - NaCl) + 100}{15·96} = x,$$

x being in this case nitrate of sodium, nitrate of ammonium in solution is resolved on boiling into nitrogen and water. The applicability of this phenomenon to the estimation of nitrites will form the subject of a future communication.

Many of the numerous experiments necessarily performed in connexion with this paper were made by my late assistant, Mr. Arthur Cranwill, to whom I take this opportunity of tendering my thanks.

On the Constitution of the Acids belonging to the Acetic, Lactic, and Acrylic Series,* *by Professor* FRANKLAND.

IN conjunction with Mr. Duppa, the author had for some time past been engaged in investigating synthetically the constitution of the acids belonging to the

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* Read before the British Association Birmingham meeting, Section B.

acetic, lactic, and acrylic series. They had succeeded in building up the higher members of the acetic series from acetic acid itself, by the substitution of hydrogen in that acid atom for atom, by the alcohol radicals, methyl, ethyl, &c. Numerous new members of the lactic series had been in like manner constructed from oxalic acid by the substitution of one atom of oxygen ($O = 16$) by two atoms of the alcohol radicals, whilst several members of the acrylic series had been produced from the lactic series by the abstraction of an atom of water from the latter.

These investigations had led to the following conclusions:—

1. The acids of all three series are constructed upon the radical type. They are all double radicals, composed of a chlorous and a basylous constituent.

2. The chlorous constituent is the same in all, and consists of an atom of methyl, in which two atoms of hydrogen are replaced by one of oxygen, and the remaining atom by hydroxyl,

$$C\left\{\begin{array}{l}O''\\ OH\end{array}\right.$$

It is this chlorous constituent which determines the basicity of these acids.

3. The basylous constituent is variable, both homologously and heterologously. Its homologous variation produces the different members of each series; thus in the acetic series we have:—

$$\left\{\begin{array}{l}C\left\{\begin{array}{l}H\\ H\\ H\end{array}\right.\\ C\left\{\begin{array}{l}O''\\ OH\end{array}\right.\end{array}\right. \qquad \left\{\begin{array}{l}C\left\{\begin{array}{l}CH_3\\ H\\ H\end{array}\right.\\ C\left\{\begin{array}{l}O''\\ OH\end{array}\right.\end{array}\right. \qquad \begin{array}{l}C\left\{\begin{array}{l}C_2H_5\\ H\\ H\end{array}\right.\\ C\left\{\begin{array}{l}O''\\ OH\end{array}\right.\end{array}$$

Acetic Acid. Propionic Acid. Butyric Acid.

Its heterologous variation, on the other hand, gives rise to different series of acids, of which the acetic, lactic, and acrylic are examples. In the acetic series the basylous constituent is always an alcohol radical derived from methyl (except in formic acid, where it is hydrogen). In the lactic series it is an alcohol radical derived from methyl, in which one of the typical atoms of hydrogen is replaced by hydroxyl (OH); whilst in the acrylic series it is a similar alcohol radical, in which two of the typical atoms of hydrogen are replaced by a diatomic member of the olefiant gas family. The relations of these three series of acids to each other and to methyl may therefore be thus simply expressed:—

Acetic Series. Lactic Series. Acrylic Series.

$$C_2\left\{\begin{array}{l}H\\ H\\ H\\ \hline H\\ H\\ H\end{array}\right. \qquad C_2\left\{\begin{array}{l}H\\ H\\ H\\ \hline O''\\ \\ OH\end{array}\right. \qquad C_2\left\{\begin{array}{l}H\\ H\\ OH\\ \hline O\\ \\ OH\end{array}\right. \qquad C_2\left\{\begin{array}{l}H\\ CH_2''\\ \hline O\\ OH\end{array}\right.$$

Methyl. Acetic Acid. Glycollic Acid. Acrylic Acid.

After the paper of which the foregoing is an abstract had been read, Dr. Hofmann, who temporarily occupied the chair, made the following observations:—

He sincerely regretted that in the temporary absence of their eloquent president it devolved upon him to address them on the memorable occasion of Dr. Frankland's communication. He congratulated the meeting on the privilege they had enjoyed in listening to a *resumé* of a series of inquiries, which in his opinion would form an era in the history of organic chemistry. For many years one of the leading aspirations of philosophers, working in the field of organic chemistry, had been the elucidation of the internal constitutions of the endless variety of carbon compounds, but he thought that in future times the important researches performed by Drs. Frankland and Duppa on the synthesis of organic acids would be looked upon as the true foundation of what might be termed the anatomy of organic chemistry. These researches, of which an admirably lucid account had been laid before them by Dr. Frankland, had produced a profound impression upon chemists. He had lately travelled leisurely from Berlin to Birmingham, visiting all the universities and schools that lay on his way. Wherever he came the first question of his chemical friends was invariably, Have you heard of the recent experiments of Frankland and Duppa? As a remarkable feature of these experiments he must mention that there was scarcely a chemist who had not, at one time or another of his scientific career, endeavoured to produce ethylacetic acid. The formation of this compound, which hitherto had been nothing more than a pleasant chemical dream, had at last been realised by a reaction which in beauty, simplicity, and generality could not be easily surpassed.

The Reciprocal Action of Glycerine and Oxalic Acid; application to the Industrial Preparation of Concentrated and Monohydrated Formic Acid, by M. Lorin.*

Formic acid may be obtained by the splitting up of oxalic acid under the influence of glycerine. The preparation by this reaction is regular, provided water be added to the mixture so as to determine the separation of the dissolved formic acid, which is retained to about 200°, and finally decomposes into water and carbonic oxide. Procured in this way, the acid contains from 4 to 5 per cent. of real formic acid.

I. Industrial Preparation of Formic Acid at 56 Centiemes.—The mixture of ordinary oxalic acid with dehydrated or commercial glycerine is heated in a retort. At 75° the reaction will commence, and will be in full activity at 90°. Simultaneously with the disengagement of carbonic acid, an aqueous liquid passes, charged with formic acid. By the addition of a fresh quantity of oxalic acid—added some time after the carbonic acid has ceased to be disengaged, the decomposition immediately recommences; a liquid again passes still richer in formic acid; and by successive additions of oxalic acid, the richness in formic acid, of the liquid obtained during this series of reactions, is always on the increase, until it reaches a limit which is precisely that which crystallised oxalic acid should give. The equation—

$$C_4H_2O_8.4HO = C_2H_2O_4 + 4HO + C_2O_4$$

shows that 126 grammes of oxalic acid furnish 82 grammes of aqueous formic acid, which ought to contain, and, in fact, does contain, 56 per cent. of true formic acid. The existence of this limit is the result of the repeated and successive combination of the formic acid, held back by the glycerine, with this polyatomic alcohol,—a combination rendered especially evident by the fact that the quantity of water eliminated from the glycerine is equivalent to the quantity of formic acid fixed in each of the successive phases of the reaction.

In one series of experiments the aqueous formic acid from each kilogramme of oxalic acid, added in portions of 250 grammes, titrated 24, 44, 53; in a second series, 17, 33, 41, 46, 50, and 51·5; the standard was raised more rapidly at the commencement of the operation. The excess of water, shown by these experiments to

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* *Comptes Rendus*, lxi., 382.

exist in the first products, appears, then, to be the result of the formation of a compound of glycerine and formic acid, the acid being regularly produced only after this compound has ceased to be formed. The limit of saturation has been found to correspond to 70 centiemes of the quantity of formic acid which would have been necessary to saturate the glycerine, giving a monoformine.

This method of preparing formic acid of 56 per cent. is so continuous and regular that it is one of the easiest of chemical operations. No attention need be paid to the temperature, the disengagement of carbonic acid forming the initial and final phases of the operation. Starting with 1 kilogramme of glycerine, and by successively adding 250 grammes of oxalic acid, we obtain, for each kilogramme of acid added at one time, 650 grammes of formic acid at 56 per cent. It is moreover evident that under these conditions an equal weight of formic acid at 25 per cent. costs no more than the oxalic acid which has served to produce it; for by the addition of water, forming a litre of each quantity of formic acid collected in the second series of experiments, I obtained the standards 21, 26, 31, 33, 34. The glycerine being saturated, 1 kilogramme of oxalic acid furnished 1·5 kilog. of formic acid, at 25. The operation may be prolonged to any extent, and if after being used a long time it is found necessary to change the glycerine, it will be on account of the impossibility of avoiding the almost imperceptible losses, and of the presence of impurities in the oxalic acid. I have, however, used the same glycerine for several months, the operations continuing incessantly night and day.

II. Formic Acid at 75 Centiemes.—By making dehydrated oxalic acid act on saturated glycerine, I obtain formic acid at an average standard of 75. The heat, however, requires very careful management to avoid frothing. The decomposition of oxalic acid commences at 50°.

III. Monohydrated and Crystallisable Formic Acid.—Monohydrated formic acid has hitherto been obtained by decomposing formiate of lead by sulphuretted hydrogen, a long and difficult operation, which in unpractised hands is rarely successful. I have, in the first place, substituted formiate of copper, comparatively a very soluble salt, for formiate of lead, it being more easily crystallised, dehydrated, and decomposed by sulphuretted hydrogen, and giving the theoretical quantity of formic acid. This is probably not the only case in which salt of copper would be preferable to salt of lead for the preparation of organic acids. It occurred to me, however, that the 25 per cent. of water might be eliminated from the 75 per cent. acid by the use of anhydrous oxalic acid. On making this acid react at 70° on formic acid, the temperature rises, the mixture becomes liquid when carefully heated, and when left to stand it crystallises; by decanting and distilling to separate the dissolved oxalic acid, formic acid, at a standard of about 100 is obtained, which, by a proper lowering of the temperature, gives crystallisable formic acid.

IV. Various Experiments. — In the course of these researches I have observed the following facts: —1. That of all the formiates, formiate of copper alone when decomposed by heat, gives formic acid of only a certain degree of concentration—82. 2. Whatever precautions I have taken, I have rarely obtained acids at 70 by the action of sulphuric acid on formiates, and those always in relatively small quantities. With biformiate I have been not more successful. 3. The splitting up of ordinary or dehydrated oxalic acid under the influence of acetic and formic acids, may be utilised in the preparation of formic acid. 4. Dehydrated oxalic acid, submitted to the moderate action of heat, furnished in one experiment a considerable quantity of formic acid at 55°. 5. From a theoretical point of view the use of sulphuric acid as an absorbent of aqueous vapour, is of some interest. I have operated on formic acid at 57·5 in the months of November and December, at the ordinary temperature of the laboratory; by once in every three days weighing and taking the standard, always at the same hour, I was enabled carefully to follow the phenomenon. Water is always absorbed more rapidly than the acid, and the standard rises to 63; the relation between the acid and water converges, and remains at about the limit 1·7. This relation, which differs a little from $\frac{46}{27}$ = 1·704, seems to indicate, under these conditions, the existence of a hydrate of formic acid, corresponding to the formula—

$$C_2H_2O_4 \cdot 3HO$$

Renewing the boiled sulphuric does not sensibly alter this relation. 6. The easier preparation of formamide, and especially that of pure carbonic oxide by formic and sulphuric acids, is another result of these researches.

TECHNICAL CHEMISTRY.

On the Results of Agricultural Experiments in 1864, by Dr. STEVENSON MACADAM.

THE experiments now referred to were undertaken at the author's suggestion by agriculturists in Roxburghshire, and they form one of the first series of field experiments undertaken in a systematic manner in Scotland. Twelve different manurial mixtures were used in the trials, and formed a set of experiments, whilst ten farmers made arrangements for carrying out the experiments in the field. The manurial mixtures employed consisted of Peruvian guano, phosphatic guano, phosphoguano, bone ash, superphosphate, guano superphosphate, sulphate of ammonia, and ground bones, taken singly or mingled together in definite proportions. The manures were analysed so as to be certain of their exact composition. In each set of experiments the various operations were conducted on the same day with the plots of ground allotted to each manure. The soils on which the experiments were made were in part of a heavy nature, and in other part of a light character—the proportion of each being equal. Each experiment was conducted on a quarter of an acre, and the twelve experiments consequently required three acres on each farm. The crop was turnips, and the yield of produce was weighed on the field. The results obtained were various on the different farms, as the manures which gave the largest return on one farm did not yield the largest crop on another. These variations are to be expected in all field experiments, and are due to the special circumstances or conditions of each field where the trials are made. Where only one set of experiments are conducted on a single farm, the local influences may materially affect the results; but where, as in the present case, the field operations are conducted on ten farms, and the mean produce of the ten trials is obtained, then the disturbing influences of one farm are counteracted or practically neutralised by those of the other farms. Taking the mean produce from the ten trials, calculated to the same money value for each of the manures, the greatest return of crop was yielded by the dissolved phosphatic guano, followed closely by the

Peruvian guano. Indeed, the difference in the produce obtained from the plots treated with these manures was so slight—only 19 lbs. to the acre—that they may be regarded as having yielded the same results. In referring to these experiments, it must be remembered that the season of 1864 was exceptionally dry, though the drought was not so great in Scotland as it was in England. The results obtained, however, are valuable as representing the produce obtainable in a dry season, and as a similar series of field experiments are being made this year in the same district, an opportunity will be obtained for contrasting the results for both years. —*Abstract of Paper read at the British Association Meeting.*

*On the Possibility of Manufacturing Néroli in the British Colonies,** *by Dr.* J. E. De Vrij.

When on my way to Java in the month of October, 1857, I passed through the South of France, my attention was fixed by the large number of orange trees cultivated in the neighbourhood of Cannes, Grasse, &c., for the purpose of manufacturing néroli, which fragrant essence is exported from the southern parts of France, and from Italy, to England and other northern countries. The high price of this essence induced me to inquire if it would not be possible to manufacture it in the colony where I was going to reside for some years.

A few months after my arrival in Java I fortunately had the opportunity of putting my idea into practice. In Bandoug, the town where I lived, which is situate at an elevation of about 2300 feet above the level of the sea, I was struck in the months of October and November by the fragrant smell of orange flowers, which perfumed the whole neighbourhood. Upon inquiring the cause I found there existed in that part many thousand shaddock trees (*Citrus decumana*) whose flowers were the cause of the fragrance. This fact appeared very curious to me, for although the fruit of the good kind of shaddock is one of the most delicious fruits in the tropics, this is only true when the tree is grown in very warm localities, as in the neighbourhood of Batavia, situate almost at the level of the sea in about 6° South latitude.

In higher localities like that of Bandoug, where the average temperature is much lower than in Batavia, the fruit of the shaddock has only the size of an ordinary orange, and is not eatable. As the many thousand shaddock trees growing in the neighbourhood of Bandoug were therefore almost useless, I thought it interesting to make some experiments on the preparation of the essence of shaddock flowers. This seemed the more interesting to me as I found the shaddock tree growing at an elevation of about 4000 feet, producing an abundance of flowers. The fact that I once collected from one tree in my garden not less than 200 lbs. weight of flowers proves the abundance of flowers that may be obtained under happy circumstances.

I must mention that the wood of the tree is very hard, and acquires a beautiful yellow colour; it may also prove to be of some value.

After a great many distillations of several hundredweights of fresh flowers, the result was that the average quantity of essence yielded by 1000 lbs. weight of fresh flowers was 1 lb.

Having ascertained the amount of product, the following question arises:— Is the essence obtained by me from the *petals* of the shaddock trees identical with the essence of orange flowers called néroli? The result of my experiments in this direction was, that the two essences are really identical, which conclusion was afterwards confirmed upon my return to Europe, by the principal manufacturers of perfumes, whom I consulted on this subject, and who declared the essence of shaddock flowers prepared by me to be identical with first-rate quality of néroli.

Another question of importance also arises:—Would the manufacture of néroli in the tropical countries pay? This can only be answered by practical experience. In Java, where I made my experiments, the local circumstances are such that the manufacture would certainly pay.

But besides the néroli obtained by distillation of the flowers, there remains in the still after the distillation a substance which deserves attention if ever my plan of preparing néroli in the tropical colonies should be carried out. If the residue in the still is thrown, yet boiling, upon a cloth, the clear yellowish liquid which passes through the cloth deposits after a few days a large amount of yellow crystals. My experiments with these crystals have proved that they are identical with the substance discovered in 1828 by Lebreton in unripe bitter oranges, and called by him "hesperidine." This hesperidine, which I find very widely spread in the genus Citrus, is the pure, bitter substance contained also in orange peels. As this hesperidine is a pure and quite innocent bitter substance, which can be obtained easily, and in tolerably large quantities, from shaddock flowers, it deserves, perhaps, attention as a substitute for hops.

The Composition of Esparto Fibre, or Spanish Grass, and its Employment in the Manufacture of Paper,† *by Dr.* Stevenson Macadam.

During the last three years large quantities of a grass have been obtained from Spain, and been employed in this country in the manufacture of paper. It is collected from lands which are, comparatively speaking, waste, and, when delivered in Great Britain, costs about 5*l.* 10s. to 6*l.* per ton. The recent high price of rags necessarily caused a demand for esparto fibre as a substitute for rags in the manufacture of paper; and, should the demand continue, other countries than Spain—such as Barbary, which are known to yield the same grass—will no doubt contribute largely to the supply of the raw material. The chemical composition of an average supply of esparto fibre is as follows:—

Moisture	9·62
Oil	1·23
Albuminous compounds	5·46
Ligneous fibre	56·28
Starch, gum, and sugar	22·37
Ash	5·04
	100·00

In the manufacture of esparto fibre into paper, the material is first carefully examined and cleaned, and is then subjected to the action of a solution of caustic soda. The proportion of soda employed is one-eighth of the weight of the grass, being 14 lbs. of caustic soda to the cwt. of fibre, or 2½ cwt. to the ton. The general size of boilers contains 12 cwt. of fibre, to which are added between 800 and 900 gallons of water, and 1½ cwt. or 154 lbs. of caustic soda. The boilers are either close or open, and the boiling process is carried on for six or eight hours, during which time the soda dissolves away from the fibre the albuminous compounds, oil, resin, and silica; whilst the starch and gum are also abstracted,

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* Read before the British Association Birmingham meeting.

† Read before the British Association.

and the ligneous fibre is left as a soft and pliable material of a brown colour. After washing with abundance of water the fibre is worked up into paper in a manner similar to that followed in the case of rags, only a little more bleaching powder is required. The fibre, however, is rather short in nature, and hence paper entirely made of it is extremely liable to tear. It is customary, therefore, to give strength to the paper by mixing the pulp from the esparto fibre with the pulp from the rags, and a common proportion is equal parts of the esparto and rag pulps. The paper manufactured from the Spanish grass, and more or less rags, is largely employed as a printing paper, and the majority of the Scotch newspapers are now printed on the mixed fibre and rag paper. The liquid obtained from the boilers where the original esparto fibre is acted upon by caustic soda is a dark brown coloured liquid, which still retains one-third of its original soda as caustic. Attempts which have been made to employ this liquid over again, with the addition of more soda, have shown the impracticability of getting the whole of the soda to act. Indeed, in using the proportions stated previously—viz., 14 lbs. of caustic soda to the cwt. of fibre, or in a boiler 1¼ cwt. of soda to the 12 cwt. of fibre, only 1 cwt. of soda is taken up and neutralised, and the remaining ¼ cwt. is left as caustic. Trials which have been made to use only the 1 cwt. of soda in the boilers have not been successful. The spent soda liquor necessarily contains much organic matter in solution, and being of a caustic nature, it possesses properties which render it pernicious and destructive to fish when it is run directly into a fishing stream. Even when diluted with water to the extent of many times its own volume, the liquid possesses the power of killing fish within a few hours. The large quantity of water required in paper manufactories necessitates that they be placed on the banks of streams; and whilst the destruction of trout may be a matter of little moment, yet the discharge of much spent soda liquor into a salmon stream is of much individual and national importance, tending as it does to foul the water and diminish the proportion of oxygen gas dissolved therein, besides conferring more or less caustic properties upon the water. Several instances have occurred in Scotland of the destruction of salmon and salmon fry in this manner, and even where direct poisoning might not be traced, yet it is undoubted that such discharges and the consequent fouling of the stream must tend to deteriorate the health of the fish, diminish their growth, or probably drive the fish from the stream. Two plans have been suggested and put in operation for the arrestment more or less completely of the soda liquor. The first method is the boiling down of the ley, heating the residue with carbonaceous matter, such as fine coal or sawdust, and the recovery of the soda from the calcined mass; and the second process is the reception of the liquor in large open tanks or cesspools, where the liquor may percolate through a sandy and gravelly soil. Both plans have been carried into practice, and have been successful. These are some of the principal points connected with the employment of esparto fibre or Spanish grass as a substitute for rags in the manufacture of paper, and as the fibre is obtained comparatively cheap and yields one half of its weight of paper, the manufacturers regard this grass as a great boon.

Royal Polytechnic Institution.—The evening chemistry class conducted by Professor Pepper and Mr. T. Coles, in connection with the Science and Art Department, will commence on October 17 at 8 p.m.

Chemical Researches on Hydraulic Cements, by M. E. FREMY.

THE admirable studies of Vicat on hydraulic cements have placed beyond doubt the fundamental fact that the hydraulicity of a cement is owing to the compound which is formed when limestone is calcined with clay. In the reaction of lime upon clay what bodies are formed, and to which is the hydraulicity of cements attributable? It must be remembered that this theoretical question is not yet completely solved, and that this uncertainty constitutes perhaps one of the causes of the difficulties which sometimes occur in the manufacture and employment of hydraulic cements.

In order to understand the causes which affect the solidity or the decomposition of hydraulic cements their true constitution must first be known. This important point I have principally considered in the following investigation.

In the calcination of an argillaceous limestone, Vicat admits the formation of a double silicate of alumina and lime, which, by becoming hydrated, causes the setting of hydraulic cements. The formation of a silicate gelatinisable by acids, which is found in the calcined cement, and which did not exist in the limestone before calcination, appears to confirm this theory of Vicat's.

MM. Rivot and Chatonay, in an important and admirable work on cements, admit that the calcination of an argillaceous limestone produces aluminate of lime, represented by the following formula : $Al_2O_3 3CaO$; and silicate of lime thus represented,—$SiO_3,3CaO$. When placed in contact with water these two salts produce the two following hydrates,—

$$Al_2 3CaO,6HO \quad SiO_3,3CaO,6HO,$$

which produce the setting of the cement. According to these two theories, the hydraulicity of the cements is owing to a simple phenomenon of hydration which induces the setting of the plaster.

The result of my researches serves to show that the setting of hydraulic cements in water is attributable to two different chemical actions,—1. The hydration of aluminates of lime; 2. An action in which the hydrate of lime combines with the silicates. According to one theory the calcareous aluminates and silicates found in the cements exert different influences at the moment of the setting; the former became hydrated, the latter combine with the hydrate of lime.

This theory of the hydraulicity of cements is founded on experiments instituted for the purpose of studying the properties and mutual action of the four bodies, which, according to MM. Rivot and Chatonay, constitute hydraulic cement. These four bodies are :—

1. Silicate of lime.
2. Silicate of alumina and of lime.
3. Aluminate of lime.
4. Caustic lime.

With these bodies several series of experiments were undertaken, the principal results of which I will now give.

Silicates of Lime.—I prepared silicates of lime synthetically by every possible method both in the wet way and the dry way. For this object I had recourse to the double decomposition of a soluble silicate by a salt of lime, to the reaction of hydrated silica upon lime, to the calcination at different temperatures of various mixtures of silica and lime. I thus obtained precipitated, fritted, and fused silicates of lime. These salts, reduced to an impalpable powder and mixed with water, produced pastes which slowly dried without presenting the phenomenon of setting.

I think, then, I am warranted in saying that if silicate of lime is formed in the calcination of an argillaceous limestone, the setting of the cement cannot be attributed to the hydration of this salt.

Double Silicates of Alumina and of Lime.—In this series of trials, which, like the preceding, represents many experiments, I combined silica by the dry way in all proportions, not merely with alumina and lime, but to the alumino-calcareous silicates of alkalies, and added magnesia and oxide of iron. The contact of these multiple silicates with water produced the same result as that of silicates of lime with water. They never produced a setting to be compared with that which characterises hydraulic cements.

The hydration of the double silicate of alumina and lime which may be formed in the calcination of an argillaceous limestone is not, then, the cause of the solidification of the water in hydraulic cements.

Aluminates of Lime.—I have carefully studied the properties of aluminates of lime, the importance of which in the setting of cements has been shown, and for the first time, by MM. Rivot and Chatonay. I have produced aluminates of lime by calcining mixtures of alumina and lime in various proportions and at different temperatures. To avoid sources of error arising from the presence of foreign matters, the alumina employed in my experiments was pure, and produced by calcination from ammonia alum. The lime, produced by calcination of Iceland spar, was equally pure. The lime produced from Iceland spar by calcination in a blast furnace forms a crystalline mass, which breaks like marble.

As these experiments often require the highest temperature producible by a blast furnace, and ordinary crucibles cannot resist the influence of the lime under these circumstances, I employed with great advantage black-lead crucibles in the preparation of aluminates of lime. Their only inconvenience is, they allow the sulphurous vapours of the combustible to pass, which produce traces of crystallised sulphide of calcium on the surface of the aluminates. In this calcination the influence of the sulphur may be avoided by using a double crucible of carbon and by placing powdered lime between the two walls of the crucibles.

In this study of aluminates of lime, I first observed a very curious fact—namely, that alumina is an excellent flux for lime, which even acts upon this base more strongly than silica. Operating with various proportions of lime and alumina, I obtained perfectly fused aluminates of lime by heating in the blow-pipe furnace mixtures of

80 of lime, 20 of alumina.	90 of lime, 10 of alumina.

The mixture of

93 of lime,
7 of alumina,

even is fritted and almost fused.

The calcareous aluminates, containing the largest quantity of lime, are crystallised; they have a saccharoidal fracture; their reaction is strongly alkaline; they combine with water with disengagement of heat; they may almost be compared to quick-lime.

Although the following consideration diverges from the subject in question, I cannot help calling the attention of metallurgists to the fusibility and the alkalinity of aluminates containing excess of lime.

Similar compounds absorb and strongly retain sulphur and phosphorus; their presence in the slags of furnaces does then, in some cases, eliminate from the castings the sulphur and phosphorus which are so justly feared in the preparation of iron for making steels.

These very basic aluminiates of lime, which behave in water like quicklime, play no part in the setting of hydraulic cements. But the same cannot be said of the aluminates of lime represented by the formulæ—

$$Al_2O_3,CaO,Al_2O_3,2CaO,Al_2O_3,3CaO,$$

and which are less basic than the preceding. These aluminates, when reduced to a fine powder and moistened with a small quantity of water, solidify almost instantaneously, and produce hydrates which acquire considerable hardness in water.

The aluminates of lime which set in water have also the property of agglomerating inert substances, like quartz. I mixed aluminate of lime—$Al_2O_3,2CaO$ with 50, 60, 80 per cent. of sand, and obtained powders which when mixed with water acquired the hardness and solidity of the best stones.

It is easy to understand the interest in a practical point of view presented by these mixtures of aluminate of lime and silicious substances, when it concerns the production of blocks capable of resisting the influence of atmospheric agents and sea water; the explanation of the durability of sea-proof constructions is probably the employment of blocks which are formed almost entirely of silicious substances, bound together by a small proportion of aluminate of lime.

My researches on aluminates have enabled me to explain one of the most interesting peculiarities in the manufacture of Portland cements. These highly esteemed cements are not, we know, of good quality unless produced at a very high temperature. Now I have found that aluminates of lime, which by reason of their composition solidify in water, do not acquire this property to any great extent unless exposed to an intense heat.

This curious fact I proved by heating the same mixtures of alumina and lime at different temperatures; that which was highly calcined in the wind furnace, and which had fused, was much more hydraulic than that which had been heated to a lower degree.

Thus, in the manufacture of Portland cements, the calcination makes the lime react upon the alumina at a high temperature, and determines the fusion of the calcareous aluminate, which then assumes its maximum of hydraulicity.

The result, then, of the different experiments I have analysed is, that aluminate of lime is the principal hydraulic agent in cements which set rapidly.

Is this calcareous compound the sole agent in the hydraulicity of cements? This important question remains to be examined.

(To be continued.)

PHARMACY, TOXICOLOGY, &c.

*Can Methylic Alcohol or any Derivative of it be readily Detected in Chloroform, Ether, Sweet Spirit of Nitre, and Sal Volatile?** *by Mr.* John Tuck.

It will, I think, be plain to all, that the detection of methylated spirit, under the varied forms of chloroform, ether, sweet nitre, and sal volatile, is a very different subject to its simple detection when not in any way chemically altered, and used merely as a solvent or from its preservative effects, as in the various tinctures of the Pharmacopœia. In the former case we have to deal with the spirit after it has undergone some complex

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* Read at the Pharmaceutical Conference.

changes, or been mixed with various other bodies not removeable by mere distillation, whilst in the latter we have only the plain unaltered spirit, which, although it may be contaminated with organic matter, can, nevertheless, be separated from it by simple distillation. In the case of chloroform and ether, we have to deal not with methylic or ethylic alcohols at all, but some derivatives of them; in sweet spirit of nitre and sal volatile, we have to deal with the spirit holding in solution various other bodies, solid, liquid, and gaseous; and our aim here is to remove or decompose them, so that they shall not in any way interfere with the application of the tests.

Chloroform, as is well known, can be prepared from wood naphtha, acetone, chloral, the acetates of lime, soda, and potash, oil of turpentine, and other essential oils, as well as from ethylic alcohol and methylated spirit. It is, however, generally prepared from ethylic alcohol and methylated spirit, because the resulting product is much purer and the yield greater than when derived from any other source. Chloroform obtained from crude wood naphtha has an empyreumatic odour very difficult of removal, but I expect this entirely results from the oily empyreumatic bodies previously existing in the naphtha. The patent naphtha would undoubtedly yield as fine a sample as any derived from pure alcohol; I am not aware, however, of any having been made from this source.

Although chloroform, like alcohol and oxalic acid, may be derived from many sources, yet, when freed from all impurities, it is of a certain, definite composition. It is said to have been known in former times, but this is very doubtful; we, however, know for certain that Dumas first pointed out its true chemical composition in 1834, and considered it to be the ter- or perchloride of the compound radical formyl C_2HCl_3. The two elements constituting the compound radical formyl exist in many organic bodies, and in the two principal sources of chloroform are as follows:—

Ethylic alcohol, or spirit of wine . . $C_4H_6O_2$
Methylic alcohol, or wood naphtha . . $C_2H_4O_2$

and when these are distilled with chloride of lime (chlorinated lime) and slaked lime, some complicated decompositions ensue, and chloroform is produced. It being clear that there can be no chemical difference in pure chloroform, from whatever source derived, and that it is formed as readily from methylic as ethylic alcohol, it is, therefore, useless to expect any chemical test for distinguishing it, when made, from methylated spirit and properly purified.

In the preparation of chloroform from wood naphtha, an oily body, lighter than water and containing chlorine, is formed. An oil is also formed in its preparation from alcohol, but it differs from the oil obtained in making it from wood spirit in being heavier than water, and in having a lower boiling-point; the crude methylated chloroform will therefore be contaminated (admitting it to be equally produced from both spirits) for a tenth part of its bulk, with a greater amount of a light oil proportionate to the greater amount yielded by wood naphtha, and it will be evident that the chloroform, if not thoroughly purified, will be of a somewhat lighter gravity than that prepared from pure alcohol,—so that, to sum up all the essential points, good chloroform, from whatever source derived, is a limpid colourless liquid, with a fragrant ethereal odour and a sweetish taste. It is entirely free from alcohol, ether, empyreumatic oils, chlorine, chloral, or any acid reaction with litmus paper. When evaporated from the palm of the hand, or better from several thicknesses of blotting-paper, it does not leave behind any strong disagreeable smell. Dropped into water it falls to the bottom, and remains perfectly bright; it has a specific gravity of about 1·496 to 1·500, and evolves no gas, or but a bubble or two, when potassium is dropped into it. It is not coloured by agitation with sulphuric acid, and is soluble in alcohol and ether in all proportions.

As the results of many experiments, I can find no difference in the behaviour of the two chloroforms respectively prepared from methylated spirit and from pure alcohol. I should state that I took every precaution to have perfectly reliable specimens of the two chloroforms as standards of comparison, and that Messrs. Duncan and Flockhart kindly assisted me in this inquiry by placing some fine specimens of the chloroforms at my service. I should also state that this eminent firm have told me that they know of no test for distinguishing the pure from the methylated chloroform.

Methylated ether is, I believe, prepared commercially in the same way as that from the pure alcohol: it must therefore be looked upon as being, under ordinary circumstances, a mixture of nearly 10 per cent. of methyl ether (probably contaminated with a small portion of sulphate of methyl) with ethyl ether. Now the problem really to be worked out is the following:—Can a mixture of 10 per cent. of methyl ether be selected in 90 per cent. of ethyl ether? These two ethers differ very much in their general properties and behaviour with other bodies; although both are oxides of their respective radicals, they, so unlike their hydrated oxides or alcohols, have no properties in common.

The oxide of ethyl, or ether, as is well known, is a very volatile, fragrant, colourless, transparent liquid, neither acid nor alkaline, and very combustible. Its specific gravity varies greatly with the temperature and the amount of spirit mixed with it; the ether of the British Pharmacopœia has a sp. gr. ·735, and is said to contain about 8 per cent. by volume of alcohol, and to boil below 105°. Absolute ether is said to have a gravity, at a temperature of 60°, of about ·720, and causes intense cold by its volatilisation. The oxide of methyl, on the contrary, is a permanent colourless gas, very soluble in water, and still more so in alcohol, wood spirit, and ether. After submitting the mixed ethers to many experiments, I have to report that I know of no other test for distinguishing the methylated from the pure alcohol ether, other than the boiling-point, first pointed out, I believe, by Macfarlane. I find, with him, that the methylated ether has a much lower boiling-point than the pure alcohol ether, the difference ranging in my experiments from 14 to 17° of Fahrenheit. I found, on boiling methylated ether with sulphuric acid (sp. gr. 1848), that it became of a decided brown colour, whilst pure alcohol ether, under the same treatment, remained quite or very nearly colourless.

The existence of methylic alcohol in sweet spirit of nitre is easily proved; without any preliminary treatment whatever, the iodo-hydrargyride of potassium clearly indicates it. The plan I adopt previous to applying the oxidation method of testing, is to mix the sweet nitre with an equal bulk of a solution of caustic potash (twice the strength of the Pharmacopœia solution), and, after allowing the mixed liquids to stand about an hour, I distil off an amount of spirit equal to the original sweet nitre, and then oxidise, as in the case of a spirit distilled from a tincture. I found, on distilling some samples of sweet nitre mixed with the solution of potash, that they boiled with explosive violence, giving off sudden jets of vapour. This, however, can be easily prevented by the well-known method of placing some portions of wire in the retort; for this purpose iron wire will do.

The method I adopt in testing sal volatile for methylic alcohol is to first dilute it with an equal amount of water, then neutralise the ammonia with dilute sulphuric acid, and distil carefully over an amount about equal to the original spirit. I then test a portion of the distillate with the iodo-hydrargyrides of potassium; and if a further test is desirable, I apply tho oxidation method of testing to another portion.

In conclusion, to sum up the results of this paper in a few words:—

Chloroform can be, and is, prepared from methylated spirit as good as, and the same in chemical composition as, that from pure alcohol; consequently, there can be no test to distinguish between them, there being no difference in them.

Methylated ether can principally be detected by its boiling point.

And the presence of methylic alcohol in sweet nitre and sal volatile can be thoroughly proved by both the iodo-hydrargyride of potassium test and the oxidation method of testing.

Wilton, near Salisbury, August, 1865.

PROCEEDINGS OF SOCIETIES.

BRITISH PHARMACEUTICAL CONFERENCE.

Birmingham Meeting.

The meeting at Birmingham was in every respect a highly-successful one. The report stated that the number of members has more than doubled during the year, and, as will be seen, a number of valuable communications were read to the meeting. The President, Mr. Deane, opened the proceedings with an excellent address, which we regret not to be able to print at length. After congratulating the members on the success of the Conference, he spoke of the publication of the British Pharmacopœia, and justified the Medical Council in the publication of bare formulæ, without notes and comments. He then spoke of the revised edition now in preparation, and as the speaker has probably good sources of information, we quote this paragraph of the address at length:—

"As you are aware, the Pharmacopœia is at present under revision by a Committee whose names are a sufficient guarantee that the work will be performed in a manner satisfactory alike to the prescriber, the pharmaceutist, and the purely scientific man; and I anticipate that the new edition will show that the existing volume contains the nucleus of the best medical code which we have yet seen. Probably it will be found that the chemical notation and some other matters of abstract science which vary with the changing opinions of scientific men will be entirely omitted. That physicians will have greater liberty in the use of the old and convenient apothecaries' symbols for grains, scruples, and drachms, and that with the general revision of the work and the removal of many existing inconsistencies, we shall have the insertion of formulæ for a large number of generally prescribed remedies for which it is most important there should be recognised galenical preparations."

The preparation of an Indian Pharmacopœia was then alluded to, and its scope described as follows:—

"Its object and aim is to supply medical men and pharmaceutists in India, as well as the medical students whose education may be conducted in the Government colleges, with a mass of information respecting the more useful drugs, including their method of preparation and administration. One object to which particular attention will be given is the introduction into notice of the more important drugs of India, hitherto but little employed except by native practitioners. As it will be necessary in most cases to describe the physical characters of the drugs, to point out their place of growth and manner of preparation, as well as to notice their therapeutical applications, the Pharmacopœia of India will have somewhat the character of a dispensatory. It is not intended to introduce into it chemical processes; and certain other drugs and preparations specified in the British Pharmacopœia will probably be omitted from that of India, as being either superfluous or not adapted to a hot climate such as that of India. It is intended that the work shall contain lists of drugs in some of the principal Indian languages, in order to facilitate the identification of drugs met with for sale in the bazaars."

Mr. Deane next spoke of accidental poisonings, the social position of chemists and druggists, the evil consequences of unnecessary competition in trade, and the necessary interference of the Excise with the sale of articles compounded with methylated spirit.

At the conclusion of the address a vote of thanks to the President was proposed, and carried by acclamation.

ACADEMY OF SCIENCES.

September 18.

M. Payen communicated a memoir "*On Iodide of Potassium.*" The author has remarked that this important medicine is rarely found in a state of purity. It is usually alkaline, and nearly always contains an excess of iodine. He has also made the curious observation that saturated solutions of iodide, and also of bromide of potassium, unlike the alkaline chlorides, act in the cold on starch granules, which, under the influence of the solutions, acquire twenty or thirty times their natural size, so that the liquid becomes a colourless, transparent mass. The commercial iodide, he states, is easily purified by saturating the potash with hydriodic acid, and by separating the excess of iodine by sulphuretted hydrogen, boiling, rest, and filtration. A solution of a salt so purified, it is said, remains colourless in a stoppered bottle after exposure to both diffuse and direct sunlight. In a slightly alkaline solution of the iodide, carbonic acid sets some iodine at liberty: atmospheric air produces the same effect, no doubt because of the carbonic acid present. With regard to the curious phenomena of the alternate colouration and decolouration of iodide of starch by heat and cooling, the author believes he has demonstrated that the decolouration by heat is occasioned by the dispersion of the amylaceous particles, the colour returning when the groups of particles contract on cooling. In conclusion, M. Payen dwelt on the necessity of using the pure iodide in medicine, and pointed out that the reaction on starch described above suggested a new inquiry into the physiological effects of the salts.

After the memoir was read, M. Chevreul made some remarks to the same effect.

Apropos to a Ministerial order, that only utensils tinned with pure tin should be used in the military hospitals, M. Jeannel gives "*A Process for Detecting Small Quantities of Lead in Tin.*" He treats five decigrammes of the metal filed off with an excess of nitric acid diluted with three times its weight of water, boils the mixture, filters, and then drops into the solution a crystal of iodide of potassium. If only one ten-thousandth of lead is present, a yellow precipitate is formed, which does not disappear on adding an excess of ammonia.

M. Gaudin presented "*A Representation in Relief of the Molecule of Chlorosulphate of Strychnia*"—a compound of two molecules of strychnia, four molecules of sulphuric acid, four atoms of chlorine, and sixteen molecules of water. No description could give our readers any idea of this figure, and we pass it, though with reluctance, since it offers a curious study.

M. P. Schutzenberger presented a note "*On the Action of Acetic Anhydride on Cellulose, Starch, Sugars, Mannite and its Congeners, the Glucosides, and certain Vegetable Colouring Matters.*" The note makes known some important facts. M. Berthelot has shown that sugars and their congeners function like polyatomic alcohols, and are capable of forming true compound ethers. He obtained these ethers by treating the sugars, &c., with a hydrated acid; but the process is tedious, and yields very small quantities of the ethers. In the case of the acetic ethers derived from sugars, &c., M. Schutzenberger has obtained much better results by using acetic anhydride. The etherification is completed in a few minutes, and, in general, does not require a higher temperature than the boiling-point of the anhydride. The only products of the reaction are hydrated acetic acid and an acetic derivative soluble in the hydrated acid, but soluble or insoluble in water, according to the nature of the substance experimented upon. In the latter case, the derivative is separated on diluting the thick syrupy liquid formed when the reaction is completed; in the former case, the syrup is diluted, decolourised, if necessary, by animal charcoal, and evaporated to dryness under the air-pump. The author at present gives only a very short account of the compounds he has obtained with starch, cellulose, cane sugar, glucose, &c., but this we are obliged to defer until next week.

M. Schutzenberger also communicated a note "*On a New and Easy Means of Preparing Gaseous Methyl or Methylide of Methyl.*" When acetic anhydride is heated with an excess of peroxide of barium, a large quantity of gas is very regularly disengaged, and acetate of barium is at the same time formed. The operation may be performed in an ordinary retort or flask with tube. The gas evolved is a mixture of exactly two volumes of carbonic acid, absorbable by potash, and one volume of a non-absorbable gas, which possesses the composition, and presents all the characters of methylide of methyl, $2(\Theta H_3)$, or hydride of ethyl. Methyl may, therefore, be prepared as easily as any other gas. The reaction by virtue of which it is obtained is accurately expressed by the equation:—

$$2\left[\left.\begin{matrix}\Theta_2H_3\Theta\\ \Theta_2H_3\Theta\end{matrix}\right\}\Theta\right] + 2Ba\Theta_2 = \underbrace{C_2\Theta_4}_{\text{4 vols.}} + \underbrace{C_2H_6}_{\text{2 vols.}} + 2\left[\left.\begin{matrix}\Theta_2H_3\Theta\\ Ba\end{matrix}\right\}\Theta\right]$$

MM. Victor De Laynes and G. Esperandieu presented a note "*On the Preparation, and some Properties, of Pyrogallic Acid.*" By the application of heat gallic acid is split up into carbonic and pyrogallic acids, and theoretically 100 parts of gallic acid should yield 74·1 of pyrogallic acid. In practice, however, the authors say that only 25 per cent. is obtained. Liebig, by carefully heating gallic acid mixed with pumice-stone in an oil bath, and carrying away the sublimed product by a current of carbonic acid, only procured from 31 to 32 per cent. of pyrogallic acid. The authors, therefore, had recourse to heating gallic acid in a closed vessel. They employed a sort of Papin's digester made of bronze, in which they placed gallic acid with two or three times its weight of water. They then applied heat, and raised the temperature to 210° C., and kept it at this point for half an hour. The whole operation lasted from an hour and a-half to two hours. The result was an almost colourless solution of pyrogallic acid, which, on evaporation, yielded an amber-coloured crystalline mass. The product was rather more than the theoretical amount, in consequence of the retention of a small quantity of water by the pyrogallic acid.

NOTICES OF BOOKS.

Practice with Science: a Series of Agricultural Papers. Part 1. July, 1865. London: Longman, Green, and Co.

"Practice with Science" is the promising and suggestive title of a new serial, whose appearance, we believe, all intelligent agriculturists will hail with delight. Empiricism in agriculture is passing away; but the science is not yet fully understood and developed. Farmers are, for the most part, before any other class, "practical men," and are only convinced of a scientific truth by the results in quarters of grain or stones of flesh. The mere title of this book—suggesting, as it does, details of the practical results of the applications of science—will therefore attract numerous readers; and this first part, at all events, will not disappoint them.

Although there are but two papers in this part that call for particular notice from us, we may express our belief that the whole of them will be read with interest. The first, on Agricultural Education, by the Principal of Cirencester College, is a good common-sense article, advocating a sound scientific but special training for the agriculturist. The next is on Agricultural Drainage, by Mr. J. Bailey Denton, whose name is a sufficient guarantee for the excellence of the article. Mr. Ransome's name, also, is enough as an authority on Ploughs and Ploughing. We might go through all the papers making a similar remark. The subjects are very varied, ranging, we may say, from the profits and management of Farm-yard Poultry up to Leases, on which there is a valuable lecture by Mr. R. G. Welford, Judge of the Birmingham County Court.

The papers we may notice are, a "Report of Wheat Experiments," by Professor Church, and "Notes on some of the Circumstances which Determine the Agricultural Value of the Natural Phosphates, with a brief account of the present methods of analysing them," by Robert Warington, jun. The latter part of this second paper we shall transfer to our pages on another occasion.

Professor Church has sought an answer to the question, Have we any ready method of selecting corn for seed, so as to enable us to get a larger and better crop? and he believes he has found the answer. Use the densest grains for seed. The following is the process by which the Professor separated the grains according to their density. The wheat was first wetted with a solution of mercuric chloride to remove the adherent air. They were then partially dried with a cloth. The seed was then placed in a capacious cylinder, and several gallons of a solution of chloride of calcium, sp. gr. 1·247 poured upon it. The liquid was gently stirred for a few minutes, the seed allowed time for subsidence, and the floating grains finally removed in a perforated ladle. The denser seed was then separated, washed, and dried.

It is necessary, the Professor states, to vary a little the strength of the calcium chloride solution according to the kind of wheat operated upon; the average strength employed corresponded to about 30 per cent. of the chloride, and to a density of 1·27. Experiments were made with four kinds of wheat, the denser seeds being selected as above, and the results are given in a table. We must content ourselves with quoting Mr. Church's conclusions:—

"1. That an average extra return of about thirteen shillings per acre may be obtained by submitting the seed sown to the particular process of selection mentioned in this paper.

"2. That a very high standard of density is not required to secure the extra return. In practice, the exclusion of 20 per cent. of the seed-wheat will probably be sufficient to ensure this result.

"3. That the process of selection by density is easy and inexpensive."

We hope to learn next year that this process has been extensively applied, and been found as advantageous as in these experiments.

We shall return to Mr. Warington's paper; and we conclude now by strongly recommending "Practice with Science" to the notice of every agriculturist.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

2123. O. Laurence, Euston Road, "A new medicine for the cure of the diseases of the stomach (dyspepsy, cardialgy, indigestion) and the hæmorrhoids."—August 17, 1865.

2129. G. H. Smith, North Perrott, Somersetshire, "An improvement in dyeing and preparing hemp and other fibres for the manufacture of yarns and fabrics."—August 18, 1865.

2150. J. B. Austin, Victoria Wharf, Blackfriars, "Improvements in apparatus for stopping bottles."—August 19, 1865.

2163. J. G. Avery, Regent Street, "A new composition suitable for use as paint and protective coating."—A communication from W. Potter, Saratoga, U.S.A.—August 22, 1865.

2101. J. G. Dale, Warrington, and R. S. Dale, Manchester, "An improved preparation for the prevention of forgery of bank cheques, bills, and other documents."—Aug. 14, 1865.

2187. C. A. Watkins, Greek Street, Westminster, "Improvements in apparatus for supplying carbonic acid gas to casks and other vessels from which beer, wine, and other fermented liquors are drawn."

2191. J. Moule, Hackney-road, "An improvement in the treatment of tar and other substances suitable to be used in the manufacture of paint, and for other purposes."—Aug. 25, 1865.

2194. J. A. Wanklyn, London, "Improvements in the manufacture of violet dye-stuffs."

2195. J. Fordred, Blackheath, "Improvements in the treatment of certain products obtained in the refining of petroleum and of other hydro-carbon oils."—Aug. 26, 1865.

2206. H. A. Bonneville, Rue du Mont Thabor, Paris, "Improvements in dyeing and fixing colours in fibres, yarns, and fabrics." A communication from A. Jeannolle, Commune de Clichy la Garonne, France.—Aug. 28, 1865.

2216. A. Gurilt, Birmingham, "Improvements in condensing and utilising sulphurous smokes and vapours, and in apparatus to be used for that purpose."—Aug. 29, 1865.

2229. W. Crookes, F.R.S., Wine Office Court, Fleet Street, "Improvements in extracting and separating gold and silver from their ores or matrices, and in the treatment of mercury employed for such purposes."

2231. J. H. Johnson, Lincoln's Inn Fields, "Improvements in tanning and in the preparation of extracts to be used therein." A communication from E D. Coëz, Paris.—Aug. 30, 1865.

2247. W. E. Newton, Chancery Lane, "Improvements in obtaining spirits of turpentine, rosin, pitch, tar, pyroligneous acid, and other products from wood." A communication from A. H. Emery, New York, U.S.A.—Aug. 31, 1865.

2267. H. Ellis, Bangor, North Wales, "Improvements in the manufacture of compounds of silica, and in the production of silicated alkaline inks, colours, and dyes."—Sept. 2, 1865.

2289. T. Nicholson, Gateshead, county of Durham, "An improved process of, and apparatus for, making caustic liquor or caustic lees."—Sept. 6, 1865.

2064. C. West, Queen's Place, Kennington Road, "An apparatus for giving immediate warning of undue heat, whether occasioned by fire, spontaneous combustion, or any other causes; of leakage in ships, and of the sudden irruption of water, and of the accumulation of choke-damp in mines."—August 9, 1865.

2120. S. Parry, Leadenhall Street, "A new and improved composition for coating iron or wooden ships' bottoms."—August 16, 1865.

2140. A. Watt, Putney, "Certain improvements in soap."—August 18, 1865.

2246. W. T. Read, Great St. Helens, London, "Improvements in apparatus for stopping bottles."

2248. W. E. Newton, Chancery Lane, "An improvement in the manufacture of paper pulp." A communication from J. B. Brown, Peckshill, New York, U.S.A.—August 31, 1865.

2252. T. Lomas, North Shields, "Improvements in the separation of sulphide of iron from coal and carbonaceous matter."—September 1, 1865.

2266. C. Reichen, Lincoln's Inn Fields, "Improvements in preparing charges for firearms and for blasting."—September 2, 1865.

Invention Protected by the Deposit of a Complete Specification.

2314. J. Casthélaz and N. Basset, Rue St. Croix de la Bretonnene, Paris, "Improvements in the manufacture of oxalic acid."—Recorded Sept. 9, 1865.

Notices to Proceed.

1793. J. M. Macrum, Knightsbridge, "Improvements in the manufacture of iron."—A communication from J. Williams and J. Copley, Pennsylvania, U.S.A.—May 7, 1865.

2023. J. A. Leon, G. Tegsimond, and J. Kissack, Liverpool, "Improvements in apparatus for filtering sugar and other liquid solutions."—August 4, 1865.

2095. H. Woodward, Cannon-street, "Improvements in carburetting coal gas and manufacturing artificial gas, and in the machinery or apparatus employed therein."—August 12, 1865.

2203. H. A. Bonneville, Paris, "Improvements in the construction of apparatus for distilling and rectifying alcohols."—A communication from F. D. Savalle, Paris.—August 28, 1865.

1266. J. Swindells, Wigan, Lancashire, "Improvements in the manufacture of coal gas."—May 6, 1865.

1278 J. C. C. Halkett, Cramond House, county Midlothian, N.B., "An improved composition for coating iron or other vessels, and for other similar purposes."—May 9, 1865.

2096. R. A. W. Westley, Camden Road, Camden Town, "A combination of improved method, apparatus, and receptacles for storing, preserving, transferring, and discharging certain fluids for sanitary and protective purposes." A communication from H. Pinkus, Boulogne, France.—Aug. 14, 1865.

1405. J. H. Johnson, Lincoln's Inn Fields, "An improved apparatus for freezing, icing, and cooling liquids." A communication from H. N. Dullmaque, Paris.

1409. R. Muller, Dartford, A. T. Weld, Gravesend, and J. F. Powell, Albion Place, Hyde Park, "Improvements in the preparation of materials to be used as substitutes for animal charcoal."—May 22, 1865.

1507. W. Clark, Chancery Lane, "Improvements in the means of carburetting or treating aëriform fluids for lighting and heating purposes, and in apparatus for the same." A communication from H. A. G. du Vergiers, Marquis de la Rochejaquelin, Paris.—June 1, 1865.

1694. F. G. David, Paris, "An improved composition for the manufacture of printers' rollers."—June 24, 1865.

Metallic Capsules.—We call the attention of our readers to the announcement of a meeting to be held at 17, Bloomsbury Square, on October 5, to take into consideration the present position of chemists and druggists in reference to the sale of capsuled articles. Recent proceedings have rendered united action on the part of the trade absolutely necessary. The best course that could be adopted would be a continuation of that already recommended—viz., to refuse to retail all capsuled articles.

CORRESPONDENCE.

Continental Science.

Paris, September 9.

An ingenious piece of parlour magic has lately been introduced by the conjuror Cleverman, who produces a snake, or what at a distance may pass for the coils of a snake, at will. Something like a pastille is placed on a plate, a light is applied, and in a moment the pastille swells up, and seems to uncurl itself, and something resembling a snake appears on the plate. The preparation made use of is sulphocyanide of mercury (mercurous sulphocyanide), which, as your readers will know, swells up when heated, and gives a very bulky laminated mass. Some nitrate of potash is mixed with the sulphocyanide, so that the heat may be applied within the mass, and the snake-like appearance of the residue is caused by the form in which the mixture is made up. Since vapour of mercury is given off in the combustion, it will not be advisable to repeat this experiment many times in one evening in a small room. Still less is it advisable to swallow one of the pastilles, as I read in *Les Mondes* a certain Prince O—— did, and so nearly killed himself. The dose did not prove fatal to the Prince; but it did to a tapeworm he had the misfortune to have associated with him. It must not be inferred from this either that sulphocyanide of mercury is a safe remedy for tapeworm. It is really a most virulent poison, and if these toys come to be sold in England, the purchasers should be particularly cautioned not to leave them in the way of children. As made up here, they are not unlike lumps of *pâte de guimauve*, and the silly young Prince O—— began to eat one, mistaking it for a bonbon!

American Manufacture of Soda from Cryolite.

To the Editor of the Chemical News.

Sir,—Allow me to trespass on the space of your valuable paper by making a remark concerning a letter in your last number. A correspondent from Philadelphia mentions the manufacture of soda from cryolite, and thinks the importation of soda ash and caustic soda from England into North America would be at an end if cryolite could be obtained in sufficient quantity.

Now, I can state, on most reliable authority (my informant is one of those German manufacturers who have a contract for part of the cryolite, and could not have any imaginable motive for imposing on me), that the entire annual yield of the cryolite mines in Greenland is 10,000 tons, and that it is impossible at present to work them for more than that. Half of this quantity, or 5000 tons, are contracted for by an American firm, and the other half by various (three or four) manufacturers in Denmark and Germany. Now, if you take in account the fact that the whole of those 10,000 tons would not cover by far the demand of a single of the large firms on the Tyne or in Lancashire, it will be apparent enough that there is no foundation whatever for the apprehensions of your correspondent.

I am, &c.

Geo. Lunge, Ph.D.

South Shields, September 26.

MISCELLANEOUS.

Prizes and Honours at the London University.—An esteemed correspondent sends us the following corrections of the statements in our last respecting the prizes at the London University:—"If you examine the calendar you will find that in January last the special honours examinations were abolished, and the candidates placed in the honours division ranked according to their proficiency in the subjects collectively. To the first of such candidates, not exceeding twenty years of age, is awarded an exhibition of 30*l*., to the second one of 20*l*., and to the third one of 15*l*., all for two years; to the fourth candidate a prize of 10*l*. in books or money, and to the fifth and sixth prizes of 5*l*. in books, philosophical instruments, or money. On page 139, col. 1, line 5 from bottom, 'twenty' should be 'twenty-*three*.' Lastly, concerning line 1, col. 1, of page 140, I must state that the division into '*groups*' was abolished by an order published about last December, and the subjects are now numbered consecutively, and one gold, one silver, and two bronze medals given in each subject."

Dr. Hofmann's "Introduction to Chemistry."—The new "Introduction to Chemistry, Experimental and Theoretic," which was announced last spring as in preparation by Dr. Hofmann will, we are informed, be issued in a few days. We hear that Dr. Hofmann has again availed himself of the colloboration of Mr. F. O. Ward, and in this work we may look for a Scientific *pendant* to the admirable treatise on Applied Chemistry published by the same authors as the "Report on Class II., Section A., of the International Exhibition." The lectures Dr. Hofmann delivered last spring at the Royal Institution constitute the framework of the book, which, in its expanded form, will present a full exposition of the new system of notation, and the modern doctrines of atomic and molecular construction. The subject is confessedly one full of obscurity, and to many the new doctrines are quite a sealed book. It is, therefore, a matter of congratulation that a profound chemist like Dr. Hofmann, and a luminous writer like Mr. F. O. Ward, have been engaged conjointly in the elucidation of the difficulties. We look forward to the publication of this treatise with great interest. By the kind permission of Dr. Hofmann, we shall shortly be enabled to give our readers a chapter or two of the contents, illustrated with the original woodcuts.

Preparation of Oxygen.—Mr. R. W. Artlett, writing to the *British Journal of Photography*, says:—"Having experimented on the valuable process for obtaining oxygen by the action of peroxide of cobalt on solution of hypochlorite of lime, with the view, among other things, of ascertaining what other substances might be possessed of the curious powers of the peroxide of cobalt, I have found that moist peroxide of iron or oxide of copper will answer the purpose. These substances, in the repeated trials I have made, have caused the evolution of a volume of oxygen equal to that obtained by means of the oxide of cobalt, and, like it, they lose none of their efficiency by use. The only difference I have observed is that, perhaps, the oxide of iron requires rather the highest heat to cause an equally rapid disengagement of gas. The oxide of copper answers perfectly, and if the oxide be not at hand, a few drops of nitrate of copper may be added to the hypochlorite of lime solution, and the gas will be given off abundantly immediately on the application of heat. I have also tried peroxide of manganese, but have not yet sufficiently investigated its action. I may, however, state that it does not accomplish the end in view so well as the other substances. The quantity of oxygen liberated is smaller, and permanganic acid is formed."

ANSWERS TO CORRESPONDENTS.

J. B.—Had better consult a medical man.

99 is thanked. For the two errors, not corrected, though evident enough, we hardly consider ourselves responsible. One is in the original French; the other in a copy furnished by the speaker.

Formation of Acetylene.—In answer to a correspondent, inquiring for the details of Dr. Odling's experiments, the Doctor writes as follows:—"I gave an account of my experiments on the formation of acetylene at the Cambridge meeting of the British Association. There is a very short note on the subject in the report of that meeting; the reaction was also mentioned in Sir Wm. Armstrong's introductory address at the Newcastle meeting, and in the appendix to the first volume of Watt's 'Dictionary of Chemistry.' I have never published the details of the experiments, having intended first to work up the matter more completely."

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

*The Action of Aldehydes on Rosaniline,** by M. Hugo Schiff.

I have in former notes described the products of the action of aldehydes on some monamines (amylamine, aniline, toluidine) and on toluylenic diamine. We now purpose giving the results of our researches on the action of aldehydes on a triamine-rosaniline.

The action of aldehydes on aniline red was ascertained in 1865 by M. Lauth, who in this way obtained violet and blue matters. M. Lauth supposes that aldehydes act on aniline red as reducing agents; but this is not the case, they act on rosaniline as on other amines; the water is eliminated, and typical hydrogen substituted by the diatomic residues of the aldehydes. Salts of rosaniline may be operated on directly. Onanthic aldehyde acts at the ordinary temperature. By pouring the aldehyde on crystallised acetate of rosaniline, the crystals lose form and lustre and absorb the liquid. Fresh quantities of the aldehyde should be added, while triturating the mixture in a capsule, so long as absorption takes place. A crystalline mass is thus obtained of a coppery appearance, moistened by water formed during the reaction. Alcohol gives a solution of a magnificent blue colour, with all the properties of a colouring matter. Caustic alkalies precipitate red crystalline flakes, giving crystalline salts with acids, coppery in appearance, insoluble in water, and containing the hexatomic base triœnanthylidene-dirosaniline

$$N_6 \left\{ \begin{array}{l} 2\text{Ȼ}_{20}{}^{\mathrm{vi}}H_{16} \\ 3\Theta_7\ H_{14}{}'' \end{array} \right. = \text{Ȼ}_{61}H_{74}N_6$$

formed according to the equation

$$2N_3 \left\{ \begin{array}{l} \Theta_{20}H_{16} \\ \qquad H_3 \end{array} \right. + 3\Theta_7H_{14}\Theta = 3H_2\Theta + N_6 \left\{ \begin{array}{l} 2\Theta_{20}H_{16} \\ 3\Theta_7H_{14} \end{array} \right.$$

The base furnishes several chloroplatinates, it combines with weak acids, and even with carbonic acid.

These salts and the hydrate of the base readily decompose below 100° C., especially in the presence of a slight excess of œnanthol, producing a yellow resinous mass containing free acid. The transformation may be effected without the least loss of weight and without disengagement of a gas, if the acid be not very volatile. In its properties the product resembles the compounds obtained by the action of benzoic and œnanthic aldehydes on aniline, toluidine, and toluylene-diamine. In fact, the greater part of the dense mass consists of a resinous diamide, œnanthylidene-ditoluène-diamide

$$N_2 \left\{ \begin{array}{l} \text{Ȼ}_7H_6 \\ \text{Ȼ}_7H_6 \\ \text{Ȼ}_7H_{14} \end{array} \right. = \Theta_{21}H_{26}N_2.$$

This amide can hardly be said to possess basic properties, but it furnishes a yellow chloroplatinate,

$$\Theta_{21}H_{26}N_2.HPt.Cl_3.$$

Were we to admit Dr. Hofmann's formula for rosaniline,

$$N_3(\Theta_6H_4.2\text{Ȼ}_7H_6.H_3),$$

it would decompose with œnanthol, according to the equation,

$$2N_3 \left\{ \begin{array}{c} \text{Ȼ}_6H_4 \\ 2\text{Ȼ}_7H_6 \\ H_3 \end{array} \right. + 3\text{Ȼ}_7H_{14}\Theta =$$

$$N_2 \left\{ \begin{array}{l} \text{Ȼ}_6H_4 \\ \text{Ȼ}_6H_4 \\ \text{Ȼ}_7H_{14} \end{array} \right. + 2N_2 \left\{ \begin{array}{l} \text{Ȼ}_7H_6 \\ \text{Ȼ}_7H_6 \\ \text{Ȼ}_7H_{14} \end{array} \right. + 3H_2\Theta.$$

I have not hitherto succeeded in isolating the diphénylénic diamide which figures in this equation, but the microscopic inspection and chemical analysis of a great number of chloroplatinates puts it beyond doubt that by the decomposition of œnanthic rosaniline at least two amides are formed, one of which must have an equivalent lower than that of the above compound.

The action of benzoic aldehyde, slow at 90°—100°, furnishes, in the first place, a violet mass, which, according to the analyses of chloroplatinate, seems to contain the intermediate compound toluydenic rosaniline

$$N_3 \left\{ \begin{array}{l} \Theta_{20}H_{16} \\ \Theta_7\ H_6 \\ \quad\ \ H \end{array} \right. = \Theta_{27}H_{23}N_3.$$

The complete substitution is with difficulty effected at 120°, and gives a crystalline product, copper coloured and possessing almost exactly the properties of the œnanthic compound.

I had hoped that the decomposition of rosaniline by benzoic aldehyde would furnish one of the terms intermediate between hydrobenzamide and amarina, described in a previous note, but its decomposition is not analogous to that of the œnanthic compound. The decomposition in this case takes place very slowly, even at 150° to 160°, and in presence of an excess of benzoic aldehyde. A dense yellow liquid is finally obtained, which gives up its excess of aldehyde on treatment with alcohol, leaving a sandy powder, very little soluble in alcohol and ether, insoluble in caustic alkalies and acids, even when concentrated, but furnishing a chloroplatinate with from 11 to 11·5 per cent. of platinum. The final action of acetic aldehyde on acetate of rosaniline causes the formation of an analogous substance. These substances neither possess the properties of toluenic diamides nor those of a derivative of leucaniline.

In conclusion, I would observe that the products of substitution furnished by aldehydes with rosaniline support the formula by which M. Hofmann denotes the connexion between aniline red and blue.

Mineralogical Chemistry; Studies on the Immediate Analysis of Minerals, by M. G. Lechartier.†

Analyses made by the same chemist, of different varieties of the same kind of mineral, frequently present considerable differences in their results. The cause of this diversity is to be traced to the impurity of the substances analysed. A careful observation of natural crystals shows how difficult it is to obtain an isolated mineral substance. Sometimes these crystals are mixed with foreign matters, sometimes they have undergone a mere or less radical alteration. Often the pure crystals exist only in very small quantities, in rare specimens, to be found only in very few places. When they can be found they serve to determine the chemical composition which will be the typical composition of the whole mineral. But it remains to be shown that the composition of the other varieties which are less pure is identical. Hence the necessity of purifying crystals without altering them. It is at all events needful, by carefully observing the impurities mixed with them, by analysing them, to show cause for the differences between the results obtained and the composition of the mineral type.

M. Ch. Sainte-Claire Deville, in his great work on feldspaths, proves the importance of isolating, by careful sorting, the matter to be analysed. It was by devoting a considerable length of time to this operation that he discovered the simple chemical connexion between the

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* *Comptes Rendus*, lxi, 45.

† *Bulletin de la Société Chimique*, 1865.

numerous minerals of this group, and added several varieties to the list, which had been separated from it.

Without these precautions, it would be found necessary, after the most careful analyses of matters supposed to be pure, to admit different compositions for the varieties of the same substance, all having the same crystallographic characteristics, or to admit that two bodies, such as silica and aluminia, are isomorphous, though no fact in chemistry justifies such an hypothesis. The first of these results is produced by the staurotide; the second by amphiboles.

Such are the difficulties which I have endeavoured to overcome by these researches, made in the laboratory of the Ecole Normale Superieure. As a pupil of M. Henri Sainte-Claire Deville, I have endeavoured to apply his lessons, and have throughout been much indebted to his advice.

Analytical Processes.—I followed exactly M. H. Sainte-Claire Deville's analysis of silicates, described in the *Annales de Physique et de Chimie*, xxxviii., 5.

The purity of the isolated elements, and especially of silica and magnesia, has always been acknowledged. I dissolved the silicate in pure hydrofluoric acid, and obtained crystallised hydrofluate of fluoride of potassium. I slowly evaporated the hydrofluoric liquid with a few drops of sulphuric acid added to it. The sulphates remaining alono in the capsule were calcined at red heat, and the weight of oxides subtracted from the first weight obtained. A similar operation was performed with magnesia, which was dissolved in nitrate of ammonia.

Determination of the degree of Oxidation of Iron in the Silicate.—In the analytical process hitherto employed the mineral is attacked by borax, or boric acid, dissolved in an acid, and protoxide of iron estimated in the solution by means of a standard solution of permanganate of potash. In this operation it is indispensable to avoid oxydising bodies and reducing gases, and this is very difficult.

I have tried to find a process by which might be determined, by means of the balance, the quantity of oxygen combined with the iron. Were the determination to be made on free oxide of iron, it would suffice to reduce a given weight of dry oxide in a hydrogen current.

There are some silicates on which hydrogen has no action, among them are staurotide and augite; on others its action is incomplete, but on heating the silicate, mixed with sufficient carbonate of lime to render it attackable by acids, in a hydrogen current, the oxide is perfectly reduced. The advantage of this process is that the operation is performed on the very substance serving for the complete analysis of the silicate; it is effected at the same time that the mineral is attacked by the lime.

The oxygen being determined by the difference of weight, all the volatile elements must be eliminated, by heating the mineral to redness in a pure and dry current of nitrogen, and the water, if there be any, collected on coming from the tube and weighed.

To reduce oxide of iron, mix the matter thoroughly with a given weight of pure carbonate of lime, and put the whole in a platinum vessel, previously tared, in a stoppered glass tube. Weigh the mixture, after having dried it at a low temperature. Place the vessel, by means of a slide in a platinum tube, which heat over a gas furnace. Pass into the apparatus a regular current of hydrogen, purified by its passage through a flask filled with fragments of potash, and a glass tube containing platinum black, heated to a little below nascent red heat.

At the temperature given by the gas furnace, a reaction takes place between the carbonate of lime and the silicate; carbonic acid is disengaged, and the oxide of iron is reduced. Continue the action of the hydrogen until the weight remains constant. A current of dry air afterwards rapidly oxidises the iron. Fuse the mixture in a platinum crucible, and analyse the glass in the usual way. The weight of iron is determined in the analysis.

Accidental Formation of Sulphide of Silver (Argyrose), by Dr. T. L. PHIPSON, *F.C.S.*

ABOUT eighteen months ago I filled a silver match-box with the common large French matches which are used in the cafés, &c., at Paris. On my return to London this box lay for many months in a drawer that was rather damp. On opening the box recently, I was surprised to find the inside lined with very brilliant crystals of a black colour and metallic lustre, which reminded me at once of some specimens of silver ore I had received a few months back from the Don Pedro mines of Mexico. I had no doubt these crystals—modified octahedra of the first system—were argyrose (or silver glance) accidentally formed. On examining them with a powerful lens, which enabled me to make a drawing of their crystalline form, and finding afterwards that they contained about 87 per cent. of silver, this supposition proved exact. It is, therefore, not improbable that this mineral may have been formed in nature by the prolonged action of sulphurous vapours upon metallic silver.

On the Strength of Solutions of Phosphoric Acid of Various Densities, by Mr.* JOHN WATTS, *Senior Bell Scholar in the Laboratories of the Pharmaceutical Society.*

THE utility of a table which shows at a glance the percentage strength of a solution whose specific gravity is known, will at once, I think, be admitted by all. The force of this is shown by the fact that, many years ago, MM. Bineau and Otto compiled the first table of the kind, sulphuric acid being the substance operated upon; this was soon afterwards followed by nitric and hydrochloric acids by Dr. Ure; and still more recently by another for ammonia. The other alkalies, potash and soda, have also been tabulated by Dalton and Fünnermann; acetic acid by Dr. Mohr, and alcohol by Fownes. These, I believe, are all which, up to the present time, have been so worked upon.

Knowing the great advantage such tables present to the practical chemist, more particularly in saving of time and labour, I undertook, as a subject for the Pharmaceutical Conference, to compile a table of phosphoric acid, so as to exhibit at once the relation between its density and its strength. . . . Although a table for phosphoric acid is not so indispensable as one for sulphuric or nitric acids, its use in the arts and manufactures being much more limited, still phosphoric acid is coming into much greater use, at least in medicine, and any one who has had the work of making the "syrup of phosphates" which are now so fashionable, knows the advantage accruing from the possession of a ready means of obtaining a knowledge of the strength of his solution. . . . In the compilation of a table of this kind, the first thing is to know at what specific gravity to start; accordingly, finding that a thick syrupy acid of 1·5 sp. gr. contained nearly 50 per cent. real PO_5. I

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* Read at the meeting of the Pharmaceutical Conference.

made that the starting point and proceeded regularly downwards as far as sp. gr. 1·006. The interval between these two numbers contains 47 specific gravities, therefore 49 in all, and as each sp. gr. was analysed at least three times in order to obtain a correct mean, it entailed the work of about 150 analyses. The table, when completed, stands as follows:—

Specific gravity	Percentage	Specific gravity	Percentage	Specific gravity	Percentage	Specific gravity	Percentage
1·508	49·60	1·369	39·21	1·236	27·30	1·095	12·18
1·492	48·41	1·356	38·00	1·226	26·36	1·081	10·44†
1·476	47·10	1·347	37·37	1·211	24·79	1·073	9·53
1·464	45·63	1·339	36·74	1·197	23·23	1·066	8·62
1·453	45·38	1·328	36·15	1·185	22·07	1·056	7·39
1·442	44·13	1·315	34·82	1·173	20·91	1·047	6·17
1·434	43·95	1·302	33·49	1·162	19·73	1·031	4·15
1·426	43·28	1·293	32·71	1·153	18·81	1·022	3·03
1·418	42·61	1·285	31·94	1·144	17·89	1·014	1·91
1·401	41·60	1·276	31·03	1·136	16·95	1·006	·790
1·392	40·86	1·268	30·13	1·124	15·64		
1·384	40·12	1·257	29·16	1·113	14·33		
1·376	39·66	1·247	28·24	1·109	13·25		

I would next notice the method employed for its analysis. Now, after essaying and testing the various advantages of a great many different processes, of which I will speak hereafter, I came to the conclusion that, with a pure solution of phosphoric acid, no method is more simple, more accurate, or less liable to error, than the method employed in the British Pharmacopœia—viz., "the evaporation down of a weighed quantity of the solution, with a known excess of pure protoxide of lead."

I confess I was somewhat disappointed when first employing this method, owing to the discordant results obtained, notwithstanding that at first sight it seems exceedingly straightforward and plain; but I afterwards found it entirely arose from not operating with pure oxide. I had used the commercial article, and though previous to each analysis it had been carefully ignited, there nevertheless remained so much carbonate and other impurities, as to render it practically worthless, no two results agreeing nearer than 2 or 3 per cent.

Finding this to be the case, I looked about for some other substance to use instead, and for this purpose tried the oxide of zinc. Analysis with this latter oxide gave perfectly accurate results as regards numbers, but was, however, open to a great objection, inasmuch as the phosphate of zinc formed readily fuses, and upon ignition towards the end of the analysis to get rid of the last traces of water, the phosphate fusing, and adhering tenaciously to the bottom of the crucible, from which it cannot be subsequently removed, entirely spoils it for a second operation. Oxide of magnesia answered no better, for this, unlike the oxides of lead and zinc, forms a hydrate when put into water; and, as is the case with many magnesia salts, either the last traces of this water of hydration, or the atom of basic water assimilated when neutralising the PO_5 is so difficult to totally expel, even after powerful ignition, that one can never be certain that the whole of the water is driven off unless the capsule has been allowed to cool and re-ignited several times, which, with such a number of similar analyses, causes much unnecessary trouble. . . . I tried also the volumetric nitrate of uranium process, but as the results never approach nearer than five to six per cent., a discrepancy too great to be allowed in a case like this, it was given up. . . . Determined then to revert again to oxide of lead, and to prepare a pure oxide myself, I took red lead ($2PbO + PbO_2$), and dissolving out the protoxide with dilute nitric acid, washed well the resulting binoxide; this, by careful ignition over an air-flame, loses its extra oxygen atom, and passes with incandescence to the state of protoxide. Working with oxide prepared in this manner I obtained highly satisfactory results, and subsequently used this method only for the completion of the analysis of the table. By examining the gradation of the numbers on the table, we see that the percentage increases or decreases regularly according as the specific gravity rises or falls, proving that the strength can be correctly deduced from a knowledge of its density and that, unlike acetic acid, it presents no anomaly in this respect; also, that when a strong acid is diluted with water, though a considerable quantity of heat is evolved, no condensation in volume follows. The correctness of the numbers may be also somewhat checked in the following manner:—

Take 100 fluid grains of 1·508 acid, this will weigh 150·8 grs., and contain 74·79 grs. by weight of PO_5 dilute this with 100 fl. grs. of water, the whole will weigh 250·8 grs., and contain 74·79 grs. by weight of PO_5; each 100 parts by weight will be therefore of sp. gr. 1·254, and contain theoretically 29·7 parts by weight of acid; by referring to the latter sp. gr. on the table, we find by experiment such number to contain 29·16 per cent. Again, 100 fl. grs. of acid 1·285 sp. gr. will weigh 128·5 grs., and contain 41·03 grs. by weight of PO_5; diluted with 100 fl. grs. of water, will weigh 228·5 grs., and contain 41·03 grs. of acid, being of sp. gr. 1·142; each 100 parts of this sp. gr. should contain, then, 17·9 by weight of PO_5. Reference to the table shows us 17·89 per cent. I have checked a great many numbers in this manner, and they all come correct.

The temperature at which all the specific gravities were taken was 15·5 C. (60° Fahr.). This is, of course, an important point in using the table, as the volume of liquid varies considerably according to the temperature; and as at different heights of the thermometer comparison of volumes no longer holds good, consequently comparison of percentages would be equally fallacious.

Very little more remains to be said, as this is not a comprehensive subject which requires much dwelling upon. I might add that the acid used was prepared from common phosphorus in the ordinary manner; but I have since made several samples of acid from amorphous phosphorus as first mentioned by Mr. Groves, and decidedly prefer this latter method; the phosphorus is readily acted upon, entails no danger in the process, and a product is obtained in a few hours which ordinarily would take as many days. One little objection appeared, which is apt to make one think that the product is not absolutely pure, viz., that in the concentrated state it was more or less coloured, possessing a brownish or yellow tint; this might have arisen from the particular specimen of amorphous phosphorus operated upon: probably another sample would not show this defect.

Lastly, I think I have shown, as far as practicable, the corrections of the table in question; and I know this, that in quantitative analysis generally, and more especially when work is published for the use or guidance of others, as in the present instance, it behoves me to accept only thoroughly-substantiated and verified results, else an incorrect analysis, while it brings one's own name into disrepute, at the same time misleads and falsifies the labours of others. It only remains now to be seen whether the table prove in practice as useful as it was anticipated to be.

Baker Street, Portman Square, W

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† Ph. Br.

Note on Nitrite of Soda,[*] *by Mr.* W. D. Howard.

Mr. Warington's able paper in the *Pharmaceutical Journal* for July has pretty much exhausted this subject. I do not, however, remember to have seen noticed a tolerably ready method for purifying the rough nitrite of soda from much of the undecomposed nitrate which in practice it always retains. This method consists in taking advantage of the slight difference in solubility between the two salts, which is sufficient to enable the nitrate to be in great measure removed before the nitrite begins to crystallise out. A sample of rough nitrite treated in this way, which originally contained 18·9 per cent. of nitrite of soda, was purified till it yielded 40·3 per cent. As the crude nitrite invariably contains either carbonate of soda, caustic soda, or a mixture of both, this method will not alone enable a perfectly pure product to be prepared.

TECHNICAL CHEMISTRY.

Chemical Researches on Hydraulic Cements, *by M.* E. Fremy.

(Continued from page 153.)

Action of Fat Lime on Various Bodies.—If in the calcination of an argillaceous limestone aluminate of lime is produced, the hydraulic properties of which cannot be doubted, there is also formed, without doubt, during the calcination, a silicate of lime and a silicate of alumina and lime, which, as we know, gelatinise with acids, but do not hydrate in water. Must it be admitted that silicate of lime and the double silicate of alumina and lime, which exist in all hydraulic cements, play no part in the setting of cements in contact with water? I think not; and the following experiments seem to confirm this opinion.

I have already said that these silicates exercise no direct action upon water, and cannot in this respect be compared to calcareous aluminates. But a cement after its calcination contains free lime; aluminate of lime, by decomposing in water, may also produce it. I considered that this base might perhaps exercise an action upon bodies which do not immediately hydrate, and cause them to play the part of puzzolana. It was on account of this hypothesis that I undertook the following experiments on the composition and properties of the puzzolanas:—

The first thing I had to ascertain was whether, in cements and mortars, lime acts otherwise than by obsorbing the carbonic acid of the air or in forming a hydrate which solidifies whilst drying.

We know that lately the chemical action of hydrate of lime on puzzolanas has been strongly contested. My experiments leave no doubt on this point, and show that there really exists a certain number of bodies which, when cold, form a combination with hydrated lime, and produce masses which solidify in water.

To determine the nature of the bodies which possess this remarkable property, I took almost all the natural and artificial compounds which by nature form combinations with lime. I mixed them with variable quantities of anhydrous or hydrated lime.

The bodies principally experimented on were silica and alumina in their various states, clay dried and baked at different temperatures, baked earths, natural or artificial silicates, the principal rocks, insoluble phosphates and carbonates, bodies remarkable for their porosity, such as animal charcoal, and several manufacturing products. In fact, I took all the compounds which, by reason of their chemical composition or their physical properties, their chemical or their capillary affinity, will combine or unite mechanically with lime. I equally desired to determine the condition of the lime which is best suited for the puzzolanic action.

My experiments showed that the compound which is formed by carefully hydrating the lime, and which may be thus represented CaO,HO, is that which, under the influence of water, combines with the puzzolanas with the greatest facility. I have shown besides that true puzzolanas—that is to say, those which form a combination with hydrate of lime when cold, solidifying in water—are much rarer than one would imagine.

Baked earths, volcanic substances, more or less calcined clays which are generally considered as puzzolanas, should not be comprised in this class of bodies, and, with a few exceptions, do not harden on their contact with hydrate of lime.

The really active bodies, the true puzzolanas, are the simple or multiple silicates of lime, which only contain 30 or 40 per cent. of silica, and which are sufficiently basic to gelatinise with acids.

As these good hydraulic cements contain the very basic, simple or multiple, silicates which gelatinise with acids, I have been led to admit that the part of these bodies in the setting of cements is to act as puzzolanas, and combine, under the influence of water, with the free lime which exists in cements.

These observations coincide exactly with those of M. Chevreul, in which he has shown that puzzolanas unite with lime on account of a phenomenon of capillary affinity.

After having studied the properties and composition of the different elements found in cements, I sum up the theory of their hydraulicity in the following propositions:

I do not admit what is still generally believed—namely, that the setting of hydraulic cements is due to the hydration of silicate of lime or that of double silicate of alumina and lime. These salts form no combination with water.

I attribute the setting of a hydraulic cement to two chemical actions:—1st, to the hydration of aluminates of lime; 2nd, to the reaction of hydrate of lime upon the silicate of lime and the silicate of alumina and lime which exist in all cements, and in this case act as puzzolanas.

The calcination of an argillaceous limestone produces a good hydraulic cement only when the proportions of clay and lime are such that they form, in the first place, an aluminate of lime, represented by one of the following formulæ: Al_2O_3,CaO—$Al_2O_3,2CaO$—$Al_2O_3,3CaO$; in the second place, a very basic simple or multiple silicate of lime, which gelatinises with acids and approximates to the following formulæ: $SiO_3,2CaO$—$SiO_3,3CaO$; and thirdly, free lime, which may act upon the preceding puzzolanic silicates.

In many cases the chemical composition of an argillaceous limestone is not the only condition which determines the quality of the cement; the reaction of the lime upon the clay must take place at the highest temperature. Indeed, this excessive heat produces the hydraulic elements of the cement in the basic conditions which the setting in water requires, and which by melting the aluminate of lime gives it all its activity.

Such are the relative theoretical conditions of the hydraulicity of cements which result from the experiments of this first research. In another paper I shall show the practical utility of these researches.

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[*] Read before the Pharmaceutical Conference.

PHARMACY, TOXICOLOGY, &c.

On the Purity of Commercial Bromides and Iodides other than Iodide of Potassium,[*] *by* HENRY MATTHEWS, *F.C.S.*

NINETEEN samples of bromides and iodides were examined, consisting of seven samples of bromide of potassium and three each of the bromides and iodides of ammonium and cadmium. The results of the analyses are given in the tables annexed.

Bromide of Potassium.

	I.	II.	III.	IV.	V.	VI.	VII.
Carbonate .	0·5	0·45	0·	0·	0·	0·	0·25
Sulphate .	0·25	1·08	0·87	0·57	0·	0·	0·51
Bromate .	0·	trace	trace	0·	0·	0·	trace
Chloride .	3·28	5·01	1·95	2·83	0·	0·7	2·11
Iodide .	0·51	trace	2·11	3·88	0·	0·	0·04
Water .	1·69	0·8	0·74	0·96	0·22	0·51	1·
Bromide .	93·52	92·97	93·86	91·66	100·04	98·71	95·86
	99·75	100·31	99·53	99·90	100·26	99·92	99·77

Bromides of Ammonium and Cadmium.

	Bromide of Ammonium.			Bromide of Cadmium.		
	I.	II.	III.	I.	II.	III.
Carbonate	0·	0·	0·	0·	0·	0·
Sulphate .	trace	2·99	0·	0·	0·	0·
Bromate .	0·	0·	0·	0·	0·	0·
Chloride .	0·44	0·8	1·34	0·73	0·45	0·
Iodide .	0·	trace	0·	trace	trace	0·
Water .	2·35	3·08	1·41	13·78	19·73	19·41
Bromide .	97·46	92·85	96·9	86·08	79·60	80·38
	100·25	99·72	99·65	100·59	99·78	99·79

Iodides of Ammonium and Cadmium.

	Iodide of Ammonium.			Iodide of Cadmium.		
	I.	II.	III.	I.	II.	III.
Carbonate	0·	0·	0·	0·	0·	0·
Sulphate .	6·93	0·	6·02	0·	trace	0·
Iodate .	0·	0·	0·	0·	0·	0·
Chloride .	0·07	0·08	0·23	0·08	trace	0·09
Bromide .	0·	0·	0·	0·	0·	0·
Water .	5·68	0·83	2·43	0·17	0·4	0·27
Iodide .	88·28	98·93	91·32	99·68	99·58	99·61
	99·96	99·84	100·00	99·93	99·98	99·97

The methods adopted for the determinations were—

1. Carbonate. By a standard solution of sulphuric acid, 10 cubic centimetres of which were equivalent to 0·05 grammes of KO,CO_2.

2. Sulphate. In the usual way, by precipitation with chloride of barium.

3. Chloride, bromide, and iodide. In the bromides about 2 grammes of the salt, dissolved in water, dilute nitric acid added, and then agitated with chloroform, more chloroform being added until the chloroform remained colourless. The chloroform is well washed with distilled water, and the chlorine and bromine determined in the aqueous solution by precipitation with silver, and afterwards heating a weighed portion of the precipitate in a current of chlorine. The iodine was determined by deducting the weight of the silver precipitate obtained after the removal of the iodine from the weight of a corresponding silver precipitate obtained from a portion of the original salt.

In the iodides, the chlorine and iodine were determined by weighing the precipitate by nitrate of silver, and afterwards heating a weighed portion of that precipitate in a current of chlorine.

Bromine in the iodides was searched for qualitatively by mixing a portion of the salt, dissolved in water, with dilute sulphuric acid and a little starch-paste, adding fuming nitric acid, and then chlorine water, until the blue colour produced by the iodine and starch disappears. The further addition of chlorine water will now liberate the bromine, if present, and it may be removed by means of chloroform. No bromine, however, was found in any of the samples of the iodides.

4. Water. By heating in the air-bath, at a temperature of 120° C., until a constant weight was obtained.

The results to be deduced from the analysis are, that the bromides of ammonium and cadmium and iodide of cadmium are practically pure. The same cannot be said of the bromide of potassium; and with regard to the iodide of ammonium, the principal impurity is the large quantity of sulphate found in two of the samples, and the presence of which in such quantities is somewhat difficult to account for.

The whole of the samples, with the exception of five forwarded to me by Dr. Attfield, were purchased at the shops of well-known chemists and druggists, and varied very considerably in price, the highest priced not being always the purest.

Notes on a Commercial Sample of Sulphate of Quinine,[†] *by* W. W. STODART, *F.G.S., Bristol.*

IN July last I received a sample of sulphate of quinine from Dr. Attfield, which was forwarded for the inspection of the Adulteration Committee, and a report requested. The name of the manufacturer, as stated on the label, was Auguste Thil, at Paris. I could get no information from many of the leading drug-houses in London, in answer to inquiries respecting its commercial relation and importation, nor could I obtain an original bottle till a friend bought one for me from a druggist at Cardiff. As far as I can ascertain, it is principally sold for the use of shippers and surgeons, and, as an inducement to the purchaser, is offered at a low price. In external appearance it differs much from a pure article, such as Howard's or Pelletier's. It is not so distinctly crystallised, and is more silky. It is much more soluble in diluted sulphuric acid than the genuine salt. It is not discoloured by strong nitric or sulphuric acids, showing the absence of phloridzine or salicine.

An aqueous solution of chlorine and ammonia failed to give the green tinge so characteristic of quinine. Nitrate of silver and nitric acid gave a white curdy precipitate of chloride of silver. Chloride of barium and hydrochloric acid also gave a dense precipitate of sulphate. The next test applied was that of Dr. Herapath.

Ten grains of the suspected salt, treated in the usual way, only afforded one or two very minute crystals of iodosulphate—a quantity too small to be weighed. I then tried the sulphocyanide test described by me at our last year's meeting. The resulting precipitate, under a quarter-inch lens, showed abundance of large massive crystals of sulphocyanide of cinchonine interspersed with the well-known tufts of sulphocyanide of quinidine, but none of the long acicular crystals of the quinine salt. When dissolved in water, to the extent of a scruple to the ounce, hardly any fluorescence was perceptible to the naked eye in daylight. Even the spark of a powerful Ruhmkorff's coil gave only a faint fluorescent light, which is so in-

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[*] Read before the Pharmaceutical Conference.

[†] Read before the Pharmaceutical Conference.

tense and beautiful in a solution of quinine, even when containing only the one-fourth of a grain per cent. My modification of Liebig's test was most decisive, and corroborated the above results in the most marked manner.

I cannot proceed without passing a vote of censure against the British Pharmacopœia test. The amount of water is very prejudicial to its usefulness, nor is there any rule given for the quantity of ammonia to be used, and the student will find to his vexation that, as the quantity of ammonia used differs, so will the amount of precipitate vary also. Another thing worthy of remark is, that the presence of cinchonine modifies and almost entirely masks the iodine and sulphocyanide tests for quinine. I could not get the herapathites to crystallise, or the sulphocyanides to deposit, till I had separated the quinine by ether. If I had not, therefore, been aware of this, I should have put down this specimen of quinine to have had none at all in it of the true alkaloid.

The best use to make of the Pharmacopœia method of testing is to correct any previous observation by a synthetical examination, for either of or any mixture of the three alkaloids, when treated exactly alike, show a marked distinction in their general appearance when too much ammonia is not employed. A quantitative analysis gave 41·3 per cent. of cinchonine, which would be equivalent to 36·31 of the sulphate, the remainder being quinidine and quinine,—the latter forming about 10 per cent. of the whole, and probably a mixture of hydrochlorates and sulphates.

From the foregoing experiments it is evident that the so-called sulphate of quinine is nothing of the kind, but a mixture of cinchonine and quinidine, with only a tenth of quinine. In short, it is truly what the label ironically states, a "*fabrique spéciale*," which it is the duty of the Adulteration Committee to expose, and certainly not proper for a druggist to sell as pure sulphate of quinine. On the other hand, it is very pleasing to find that such an article could not readily be procured from our well-known wholesale London houses. It proves the truth of what I affirmed at Bath, that it is the druggist's own fault if he does not get a genuine article.

On the Iodo-Hydrargyride of Potassium and the Oxidation Tests for Methylic Alcohol in the Presence of Ethylic Alcohol and some other Organic Bodies, by Mr.* JOHN TUCK.

AT the Bath meeting of the British Pharmaceutical Conference, it was shown that oil of cloves had the same effect on the iodo-hydrargyride of potassium test for methylic alcohol as acetone; it therefore became evident that some additional experiments were necessary, in order to determine whether or not the volatile oils or organic principles existing in the tinctures were in any way calculated to interfere with its application, and if so to devise some simple method whereby such interfering agent might be removed previous to the application of the test. With this object in view, I dissolved one drachm of the oil of cloves in nine drachms of spirit of wine; on testing this with the iodo-hydrargyride of potassium, as I expected, there was no precipitate. I next distilled a portion of it, and on testing the distillate I obtained the reaction characteristic of spirit of wine. This experiment teaches us that the worst possible interfering agent can readily be separated by simple distillation.

I have also distilled and tested nearly the whole of the tinctures of the British Pharmacopœia prepared with duty-paid spirit, and in no case have I met with any oil or organic principle that interfered with the test. I obtained the characteristic precipitate in every case, so that the absence of a precipitate with the iodo-hydrargyride of potassium test may be looked upon as conclusive evidence of the preparation being made with methylated spirit. The tinct. gallæ requires to be distilled carefully, otherwise some portion of the formic acid is carried over with the vapour of the spirit, and on testing it a dark precipitate is the result. In distilling tinct. iodi co. some portion of the iodine is almost sure to be carried over; but if the distillation is conducted with care the small portion that is carried over will not interfere with the test; however, if thought desirable, this may be prevented by adding potash to the tincture previous to distillation.

Since the reading of my former paper at Bath, a process has been published for the detection of methylic alcohol in the presence of ethylic alcohol and volatile oil by Mr. Miller, which is certainly the best and most reliable of all that have been brought forward. I do not, however, mean to say that any new principle has been discovered, or the new application of an old one, for even when the methylated spirit in question was under the consideration of the Board of Inland Revenue, Professors Graham, Hofmann, and Redwood reported to the Chairman that,—

"Under the influence of oxidising agents, methylic spirit furnishes, together with other products, a considerable amount of formic acid, whilst alcohol under these circumstances yields principally acetic acid. Formic and acetic acids, although closely allied in composition and general characters, still offer a greater number of points of difference than the two alcohols which they represent. Formic acid may be readily distinguished from acetic acid by the facility with which the former precipitates the metals from the solutions of the more easily reducible metallic oxides, such as oxide of silver and oxide of mercury, which are not affected by acetic acid. Unfortunately, this method of testing became inapplicable, since it was found that alcohol free from methylic spirit when submitted to the action of oxidising agents, invariably yields, in addition to aldehyde, which can be resinified and removed by potash, a small quantity of formic acid, so that the presence of formic acid among the products of oxidation of a suspected liquid cannot with certainty be regarded as an evidence of the existence of methylic spirit in the original liquid."

The method adopted by Mr. Miller in applying the principle of oxidation is not capable of being carried out easily nor quickly, but these disadvantages are counterbalanced by the certainty which attends the results of the oxidation of methylic alcohol. As stated by the learned chemists in their report to the Board of Inland Revenue, the presence of a small quantity of formic acid in the oxidation products of a suspected liquid is no proof of the existence of methylic spirit in the original; but, as ethylic alcohol only yields a very little, and as methylic alcohol yields a great amount of formic acid, its presence in quantity after the oxidation of a small portion of a suspected spirit, by whatever method it is conducted, points unmistakably to the previous presence of methylic alcohol, other sources from which it may possibly be derived of course being absent.

The sources from which formic acid may be derived by oxidation without the presence either of ethylic or methylic alcohol are many, so that in every case, before applying any method of oxidation to a suspected spirit, we should first free it from organic matter by distillation

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* Read at the Pharmaceutical Conference.

or other process,—albumen, casein, gelatine, starch, sugar, both cane and grape, tartaric acid, woody fibre, the cereal grains, and many other organic substances yielding formic acid by oxidation; it also exists, as is well known, naturally in ants, some caterpillars, oil of turpentine, the stinging-nettle, and, it is said, even in some mineral waters.

The method given by Mr. Miller in the *Pharmaceutical Journal* for last April is as follows:—"Put into the flask thirty grains of bichromate of potash, in powder, add half an ounce of water with twenty-five minims of strong sulphuric acid, and then half a fluid drachm of the spirit; allow the mixture to stand fifteen minutes, and distil half a fluid ounce. Add to the distillate a very slight excess of carbonate of soda, boil it down to two fluid drachms, and add enough acetic acid to impart a distinct though feeble acid reaction; then pour it into a test-tube, and, after adding a grain of nitrate of silver, dissolved in half a drachm of water, boil very gently for about two minutes. If the liquor merely darkens a little, but continues quite translucent, the spirit is free from methyl; but if it becomes muddy and opaque, and the tube, after being rinsed and filled with water, appears browned (best seen by holding it against white paper), the spirit is methylated."

I distilled a portion of the tinct. rhei, of which I have brought a sample, and on testing the distillate with the iodo-hydrargyride of potassium, there was no precipitate, thus indicating the presence of methylic alcohol. On carrying out the oxidation method of detecting it, I obtained further evidence of its presence, thus confirming the reliability of the iodo-hydrargyride of potassium, and proving, beyond all dispute, that the tincture was a methylated one. If a method of oxidising the methylic alcohol and of neutralising the acid so formed could be devised, without distillation, it would wonderfully simplify the oxidation test; although I have made some experiments in this direction, by heating the methylated spirit with a mixture of lime and potash, they have not yet been of a satisfactory nature. I have not tried the action of platinum black on methylated spirit, but presume it would slowly convert the ethylic alcohol into acetic acid, and the methylic into formic acid. According to Dobereiner, spongy platinum, moistened with wood spirit, does not act upon the air, but if moistened at the same time with strong caustic potash, it often becomes heated to redness, and converts the wood spirit, first into formic, and afterwards into water and carbonic acid.

As being very suitable to the present paper, and thinking, too, they would prove of interest, I have pleasure in placing before Conference eight different specimens of methylated preparations, kindly placed at my service by the Chairman of the Board of Inland Revenue, W. H. Stevenson, Esq. There are three specimens of the beverage called called "whiskee," three of "brandee," one tincture of rhubarb, and one sweet spirits of nitre. The specimens of "brandee" are all prepared with methylated spirit, without any, or at any rate but little, preparatory cleaning, and are all distinctly acid. The "Medicated Indian Brandee," and the "Cordialised Indian Brandee," are all sweetened with sugar, the French brandee or Indian tincture is different to the other two, being much higher flavoured; it is made very sweet with honey, and, I believe, contains saffron as a flavouring ingredient; the colour is derived from burnt sugar; and they all contain more or less sweet nitre. I am not at all prepared to say, positively, in what manner the sweet spirit of nitre comes to be present in these beverages; whether there is a certain amount of sweet nitre added to the methylated spirit, or whether it arises from the addition of nitric acid to the spirit, and then boiling or distilling it, is very difficult to say. I am rather inclined to believe that the latter is the true origin of it, and that the nitric acid is added with the intention of oxidising the oils in the naphtha, or at any rate modifying the taste and smell of the plain methylated spirit. The three specimens of "whiskee" differ much from each other, the medicated whiskee contains a good deal of sweet nitre, and is strongly acid, the sweetening agent here used is sugar, and it is the least sweet of all the beverages; the "Hollands flavoured whiskee" is acid, and, like the others, contains a portion of sweet nitre, and is sweetened with honey. I now come to the last, the best, and the most remarkable of this series of specimens illustrating human ingenuity in cheating the Excise, the "Pure Islay Mountain Medicated Whiskee;" this was at first a colourless and perfectly clear syrupy liquid, which, on being exposed to full daylight in a window, during some very cold weather, became turbid, and gradually deposited a lot of flocculent crystals. Not being at that time at all able to understand the formation of these crystals, I forwarded to our worthy President, Mr. Deane, two or three drops of the thick crystalline deposit, for him to examine them microscopically; after the examination, both chemical and microscopical, of this small quantity, he felt quite assured that the source of the crystals was honey. Since that time, there has been a greater deposit of these crystals, a specimen of which is on the Conference table. I have chemically examined them, and have come to the same conclusion as Mr. Deane; these crystals are, without any doubt, grape sugar, and in all probability derived from honey, which must first have been dissolved and then decolourised, for the finest sample of honey I have yet seen would certainly impart some degree of colour and turbidity to any solvent, and this specimen of "whiskee" was quite colourless and perfectly clear. Although acid, it is by no means so much so as the other specimens, and it seems also to be flavoured with a slight portion of chloroform. The spirit used in its fabrication must have undergone some kind of "cleaning" process, as this is the most pleasant beverage of the whole series. On distilling a portion of it, and applying the iodo-hydrargyride of potassium, and the oxidation method of testing the presence of methylic alcohol was thoroughly proved. The compounding of these intoxicating drinks, for it is a sham to call them by any other name (for they certainly are neither "medicinal" nor "cordial," no more than duty paid brandy, gin, or whisky), is a direct fraud upon the revenue, was never contemplated or intended to be one of the uses of methylated spirit, and should be strongly discountenanced by all honourable men. The Board of Inland Revenue liberally allows the methylated spirit duty free for the arts and manufactures; and all interested in their welfare—and who is not?—should protest by their words and deeds against the abuse of such a great boon.

To sum up this paper in a few words, I think we may now look upon the question of the "detection of methylated alcohol in the presence of ethylic alcohol and organic bodies" as thoroughly and satisfactorily answered. We can, in the first place, readily detect the acetone, which is always associated with the methylic alcohol, and by the oxidation method of testing, interfering bodies being absent, the methylic alcohol itself.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Weekly Evening Meeting, Friday, April 7.

H.R.H. THE PRINCE OF WALES, *Vice-Patron, in the Chair.*

On the Combining Power of Atoms.

By Dr. A. W. HOFMANN, *F.R.S.*

YOUR ROYAL HIGHNESS, LADIES AND GENTLEMEN,—You observe on the lecture-table a great number of bottles, containing an almost perplexing variety of chemical substances; the walls of the theatre are covered with diagrams exhibiting an endless number of formulæ, which some of my audience, I have no doubt, are contemplating with mixed feelings of uneasiness and resignation. Nor will it diminish your discomfort if I tell you that each of the substances on the table represents at least a thousand bodies actually known, and again that each of the known bodies represents a million or more bodies which are not known, but which exist well defined in the mind of the chemist, who calls them into life whenever he requires them for purposes theoretical or practical. At the first glance, I admit this is rather a formidable array; but our anxiety is materially lessened, if we learn that this host of substances is formed according to simple laws which it is in our power to discover, and which by the united efforts of chemists are gradually unfolding themselves.

May I be permitted this evening to call your attention to some of the laws, or at all events law like regularities, recently observed, and which are at present engrossing the interest of the leading chemists of all countries?

I would commence with one of the simplest of experiments:—Here are two gases, hydrogen and chlorine, the one a colourless inodorous gas, which burns quietly with a pale flame, the other a greenish yellow gas, possessing a suffocating odour, and not inflammable. When equal volumes of these two gases are mixed together, and a light applied to the mixture, an explosion takes place, a compound gas being produced, which fumes in the air, and which, when dissolved in water, constitutes the spirit of salt, or muriatic acid of the earlier chemists, now called hydrochloric acid.

By certain processes, which we must not inquire into at the present time, the compound of hydrogen and chlorine, called hydrochloric acid, may be made to unite with another gas, oxygen; the combination giving rise to the formation of an acid called hypochlorous acid, and by which most of the bleaching operations carried out in commerce are effected. On plunging an appropriately prepared piece of Turkey-red calico into a warm solution of chloride of lime, which is closely related to hypochlorous acid, you observe that a white pattern is produced on the cloth.

Again, an additional quantity of oxygen may be united to hypochlorous acid, when the compound called chlorous acid is formed. A well-known salt of commerce, chlorate of potassium, is generally used for its preparation. This salt is readily decomposed by acids. The explosive violence with which sulphuric acid acts upon it, the detonation attended by flashes of light, are phenomena early and frequently observed by the laboratory student. By substituting nitric for sulphuric acid, an explosive gas is formed, which, when dissolved in water, constitutes the chlorous acid in question.

A third compound, chloric acid, may be formed by the addition of a further dose of oxygen to chlorous acid. The most familiar salt of this acid is the chlorate of potassium just mentioned. This, as well as other derivatives of chloric acid, is largely used for pyrotechnic purposes. Here we must be satisfied with calling attention to a species of white gunpowder which has been lately devised, and which consists of a mixture of the potassium salt with tannic or gallic acid.

Lastly, by still further increasing the supply of oxygen, a fourth compound, perchloric acid, is produced. This substance again exhibits the explosive habitudes of the group of bodies in question. When made to combine with aniline, for instance, perchloric acid gives rise to a compound which goes off when heated in a test-tube, burning, as you observe, with an intense white light.

A glance at the diagram shows us the regularity with which the amount of oxygen increases in this series of oxygenated derivatives of hydrochloric acid. There is nothing arbitrary in this succession; each increment ensues step by step.

Increment of Oxygen.

Hydrochloric acid . .	HCl
Hypochlorous acid . .	$HCl + O = HClO$
Chlorous acid . . .	$HCl + 2O = HClO_2$
Chloric acid . . .	$HCl + 3O = HClO_3$
Perchloric acid . .	$HCl + 4O = HClO_4$

Looking at the simplest body at the head of the list, we find it to be a compound of one atom of hydrogen with one atom of chlorine. By uniting this compound with one atom of oxygen, we obtain hypochlorous acid; by adding another we produce chlorous acid; the accession of a third atom gives rise to chloric acid; and a fourth atom of oxygen, lastly, produces perchloric acid.

The same gradual rise in the successive additions of oxygen may be traced in numerous other groups of bodies. For the present we will confine our attention to two more series.

Under the name of olefiant gas, a transparent colourless gas, burning, as you observe, with a brilliantly luminous flame, is known, which consists of carbon and hydrogen. By a circuitous process, which must not detain us, this gas may be converted into a peculiar very volatile liquid of a pungent odour, which chemists have called aldehyde. This substance, which is more readily procured by submitting alcohol to the action of oxidising agents, may be looked upon as a compound of olefiant gas with oxygen. Aldehyde is marked by its powerful attraction for oxygen; so greedily, indeed, does it absorb this gas that it is almost impossible to preserve aldehyde except in hermetically-closed vessels. Nor does aldehyde unite only with oxygen when it meets with it in the free state; combined oxygen is equally attracted by it. When gently heated with oxide of silver, dissolved in a suitable liquid, aldehyde very rapidly removes the oxygen from the oxide, metallic silver in a lustrous condition being deposited on the surface of the vessel in which the operation is performed. This reaction, first observed by Baron Liebig many years ago, has recently been modified so as to admit of industrial application on a large scale for the manufacture of looking-glasses and reflectors for astronomical instruments. When aldehyde is thus oxidised, it is converted into a compound called acetic acid, well known to every one as the principal constituent of common vinegar.

Again, acetic acid may be made to unite with an additional quantity of oxygen to produce a compound called glycolic acid, an acid which has been discovered during the last few years, but which has not at present received any useful applications.

On referring to the following diagram, we perceive the simple relation existing between these four bodies:—

Increment of Oxygen.

Olefiant gas . . .	C_2H_4
Aldehyde . . .	$C_2H_4 + O = C_2H_4O$
Acetic acid . . .	$C_2H_4 + 2O = C_2H_4O_2$
Glycolic acid . . .	$C_2H_4 + 3O = C_2H_4O_3$

We observe here exactly as in the previous series the gradual assimilation of oxygen. Olefiant gas by absorbing one atom of oxygen produces aldehyde; by absorbing a second atom it gives rise to the formation of acetic acid; by a third annexation of a similar quantity of oxygen; lastly, glycolic acid is formed.

May I be permitted to quote an additional instance? In the oil obtained from the seeds of the *croton tiglium* chemists have discovered a peculiar acid, crotonic acid, which has been lately observed also among the derivatives of mustard.

This substance, consisting of carbon, hydrogen, and oxygen, is convertible by oxidation into another acid, succinic acid, a beautiful crystalline body, which is more frequently obtained by submitting the familiar resin amber to the action of oxidising agents.

Succinic acid, when combined with an additional atom of oxygen, gives rise to the formation of malic acid, a crystalline acid largely present in the juice of apples and rhubarb—the substance, indeed, to which the acid reaction of these juices is chiefly due. On cutting an apple or a piece of rhubarb and pressing the cut surface against a piece of blue litmus paper it is immediately reddened.

But malic acid also may be still further oxidised, the product being one of the most familiar vegetal acids, tartaric acid. This acid is one of the compounds existing largely in the juice of grapes. When a grape is squeezed on a piece of blue litmus paper, the latter is reddened wherever it comes in contact with the grape juice.

The molecules of all these acids contain the same number of carbon atoms and also the same number of hydrogen atoms, the difference in their composition consisting entirely in the number of oxygen atoms which are present, as obvious by reference to the diagram.

Increment of Oxygen.

Crotonic acid . . .	$C_4H_6O_2$
Unknown	$C_4H_6O_2 + O = C_4H_6O_3$
Succinic acid . . .	$C_4H_6O_2 + 2O = C_4H_6O_4$
Malic acid	$C_4H_6O_2 + 3O = C_4H_6O_5$
Tartaric acid . . .	$C_4H_6O_2 + 4O = C_4H_6O_6$

In this diagram an unknown acid $C_4H_6O_3$ figures between crotonic and succinic acids. This substance has not yet been obtained, but the experience of the gradual assimilation of oxygen in other series permits us to forecast the existence of this compound. Though not yet actually prepared, I have not hesitated to introduce it into the list of bodies derived from crotonic acid by simple oxidation.

The three examples which we have studied unmistakably show us that oxygen is capable of combining with other groups of elements so as to give rise to new compounds: that this combination takes place stepwise, atom by atom; that the fundamental properties of the original compound remain more or less unaltered in the new compound of greater complexity, and that the amount of oxygen thus, so to say, assimilated, is in no way dependent on the greater or less complexity of composition of the original compound. In the first case we had the simplest of all possible compounds, hydrochloric acid consisting of one atom of hydrogen and one of chlorine; in the second case we started with a compound containing two atoms of carbon and four of hydrogen, altogether six atoms, while in the case of crotonic acid not less than four atoms of carbon, six of hydrogen, and two of oxygen, altogether twelve atoms, were involved.

An endless variety of similar examples might be quoted for the purpose of illustrating the generality of the inferences we have drawn, but I will, with your permission, assume that I have established my point.

We have, in the next place, to examine whether substances are capable of combining with nitrogen, exactly as we have just seen them unite with oxygen. Remembering as we do that nitrogen is rather marked by the absence of salient combining powers, we are not surprised to learn that all attempts hitherto made with the view of adding nitrogen directly to other bodies have entirely failed. But even indirectly by availing ourselves of roundabout ways, by calling to our aid the multitude of reactions which modern chemistry has brought to light, nitrogen cannot be added to other substances without introducing at the same time other elements into the composition of the compound. Let us endeavour to illustrate this point by examples; we could not, perhaps, quote a better case than that of benzol, the substance which is the starting-point of the manufacture of aniline, the source of the beautiful colours so much in request at the present time. Benzol consists of carbon and hydrogen. No one has as yet succeeded in uniting this substance with nitrogen alone. Nothing, on the other hand, is easier than to combine benzol simultaneously with nitrogen and hydrogen. The very transition of benzol into aniline involves the assimilation by the benzol molecule of one atom of nitrogen and one atom of hydrogen. Again, aniline is capable of fixing a second atom of nitrogen, but not without assimilating also a second atom of hydrogen. The compound thus produced is a beautiful crystalline body called phenylene-diamine, which is likely to receive some interesting applications in the manufacture of brown dyes. To this compound, again, additional atoms of nitrogen and hydrogen may be joined, a fourth substance, as yet without application, picryl-triamine, being formed. The following diagram, in which, again, the simplest compound (benzol) is placed at the top of the list, shows how these several substances are related to each other:—

Increment of Nitrogen.

Benzol	C_6H_6
Aniline	$C_6H_6 + HN = C_6H_7N$
Phenylene-diamine .	$C_6H_6 + 2HN = C_6H_8N_2$
Picryl-triamine . .	$C_6H_6 + 3HN = C_6H_9N_3$

Let me give you another and even simpler series in illustration of the same point. Hydride of ethyl, like benzol, refuses to combine with nitrogen, but it also receives into its molecule one atom of nitrogen and one atom of hydrogen, the well-known substance ethylamine, which has the greatest analogy with ammonia, being formed. This, by a repetition of the same transaction, is converted into ethylene-diamine, an oily base of great causticity; while a third repetition of the process produces a compound, vinyl-triamine, the existence of which is not yet fully established. The analogy between the first and the second series is obvious by a comparison of the formulæ.

Increment of Nitrogen.

Hydride of ethyl . .	C_2H_6
Ethylamine . . .	$C_2H_6 + HN = C_2H_7N$
Ethylene-diamine . .	$C_2H_6 + 2HN = C_2H_8N_2$
Vinyltriamine . . .	$C_2H_6 + 3HN = C_2H_9N_3$

We entirely refrain from examining into the particular processes, varying to a very considerable extent, by which these transformations are accomplished, the only point, which we have an interest in establishing here, being that nitrogen, when it joins a compound, joins not alone, but in company with hydrogen. In this respect, then, nitrogen essentially differs from oxygen, which we saw combining with bodies, atom by atom, without involving the introduction of other materials.

Can we explain this strange difference in the behaviour of oxygen and nitrogen? Before endeavouring to answer this question, let us examine in what manner carbon atoms are received into the molecules of bodies, whether like oxygen atoms they are capable of joining directly, or like nitrogen atoms they are accepted only when presenting themselves in company with other atoms. Investigation of a special case appears best fitted to supply the desired information.

Among the endless number of carbon compounds, we could not possibly select a simpler one than marsh-gas. This transparent, colourless inflammable gas, as every one knows, escapes from the fissures of the great coal measures and accumulates in the galleries of ill-ventilated coal-mines, frequently giving rise to the explosions so much dreaded and deplored. It is also often developed from stagnant pools and swamps, in general from marshy lands, whence its name. Marsh-gas consists of carbon and hydrogen. Is this substance convertible into a compound which contains a larger amount of carbon? By a series of processes far too numerous and complicated to admit of being discussed this evening, marsh-gas may be converted into hydride of ethyl, a substance of very similar properties, and which the members of the Royal Institution have frequently seen prepared by a simpler method discovered by Dr. Frankland—viz., the action of zinc-ethyl upon water. Hydride of ethyl contains one atom of carbon more than marsh-gas; but with this carbon atom two hydrogen atoms have been simultaneously conferred upon the marsh-gas molecule. On submitting hydride of ethyl to a similar series of transformations, we convert it by the addition of another carbon atom into hydride of propyl, but not without fixing again two atoms of hydrogen.

The same processes may be repeated again and again, hydride of propyl being converted in its turn into hydride of butyl, and hydride of butyl into hydride of amyl. We arrive in this manner at a series of bodies very similar in their properties, each of them differing from the previous one by the accession of one carbon atom invariably linked with two atoms of hydrogen. Many members of this series are found amongst the products of the distillation of coal; others, especially those richer in carbon, existing in the American oils, which are now being so much used for lighting and other purposes.

The composition of these several bodies may be exhibited in the following diagram:—

Increment of Carbon.

Hydro-carbons.

Marsh gas	CH_4
Hydride of ethyl	$CH_4 + CH_2 = C_2H_6$
Hydride of propyl	$CH_4 + 2CH_2 = C_3H_8$
Hydride of butyl	$CH_4 + 3CH_2 = C_4H_{10}$
Hydride of amyl	$CH_4 + 4CH_2 = C_5H_{12}$
Hydride of caproyl	$CH_4 + 5CH_2 = C_6H_{14}$
Hydride of œnanthyl	$CH_4 + 6CH_2 = C_7H_{16}$
Hydride of capryl	$CH_4 + 7CH_2 = C_8H_{18}$

But we may illustrate the law which regulates the increment of carbon by starting from another foundation. Instead of building on marsh-gas, we make use of the oxide of marsh-gas, methylic alcohol. This compound, by the successive addition of one atom of carbon and two of hydrogen, produces a series of alcohols which may be regarded as the oxides of the corresponding marsh-gas analogues. The first compound thus obtained is ethylic alcohol, ordinary spirits of wine; the second, propylic alcohol, generated in the fermentation of the grape-skin residue of the manufacture of wine; the third, butylic alcohol, formed by the fermentation of the molasses of beetroot sugar; the fourth, amylic alcohol, or potato oil, obtained as a residue in the manufacture of spirit from the starch of potatoes. Caproic, œnanthylic, and caprylic alcohols are further terms of the series, which rises, not without considerable gaps, to terms containing as many as eighteen, twenty-seven, and even thirty atoms of carbon, which are found respectively in palmitic, cerotic, and melissic alcohols—the first, a product of the decomposition of spermaceti; the last two, derived from ordinary bee's wax and Chinese wax.

Increment of Carbon.

Alcohols.

Methylic	alcohol	CH_4O
Ethylic	,,	$CH_4O + CH_2 = C_2H_6O$
Propylic	,,	$CH_4O + 2CH_2 = C_3H_8O$
Butylic	,,	$CH_4O + 3CH_2 = C_4H_{10}O$
Amylic	,,	$CH_4O + 4CH_2 = C_5H_{12}O$
Caproylic	,,	$CH_4O + 5CH_2 = C_6H_{14}O$
Œnanthylic	,,	$CH_4O + 6CH_2 = C_7H_{16}O$
Caprylic	,,	$CH_4O + 7CH_2 = C_8H_{18}O$
. .	.	.
Palmitic	,,	$CH_4O + 15CH_2 = C_{16}H_{34}O$
. .	.	.
Cerotic	,,	$CH_4O + 26CH_2 = C_{27}H_{56}O$
. .	.	.
Melissic	,,	$CH_4O + 29CH_2 = C_{30}H_{62}O$

Again, we may take another compound as point of departure. Formic acid is a body long since discovered to be secreted by the ant. By adding an atom of carbon and two of hydrogen to this acid we arrive at acetic acid, which we have already met with this evening as one of the products of the oxidation of olefiant gas. By the successive accumulation, within the molecule of this acid, of similar quantities of carbon and hydrogen, a long series of acids is formed, including some of the most interesting compounds with which the chemist has to deal; butyric acid, contained in butter; valeric, the active constituent of the valerian root; caproic and caprylic, obtained from goat's fat; œnanthylic, from castor oil; pelargonic, the odoriferous principle of *pelargonium roseum;* rutic, the product of oxidation of oil of rue; palmitic, contained in palm oil and in spermaceti; margaric and stearic, constituents of the majority of animal fats; cerotic and melissic acids, lastly occurring in the several waxes.

Increment of Carbon.

Acids.

Formic	acid	CH_2O_2
Acetic	,,	$CH_2O_2 + CH_2 = C_2H_4O_2$
Propionic	,,	$CH_2O_2 + 2CH_2 = C_3H_6O_2$
Butyric	,,	$CH_2O_2 + 3CH_2 = C_4H_8O_2$
Valeric	,,	$CH_2O_2 + 4CH_2 = C_5H_{10}O_2$
Caproic	,,	$CH_2O_2 + 5CH_2 = C_6H_{12}O_2$
Œnanthylic	,,	$CH_2O_2 + 6CH_2 = C_7H_{14}O_2$
Caprylic	,,	$CH_2O_2 + 7CH_2 = C_8H_{16}O_2$
Pelargonic	,,	$CH_2O_2 + 8CH_2 = C_9H_{18}O_2$
Rutic	,,	$CH_2O_2 + 9CH_2 = C_{10}H_{20}O_2$
. .	.	.
Lauric	,,	$CH_2O_2 + 11CH_2 = C_{12}H_{24}O_2$
Cocinic	,,	$CH_2O_2 + 12CH_2 = C_{13}H_{26}O_2$
Myristic	,,	$CH_2O_2 + 13CH_2 = C_{14}H_{28}O_2$
Benic	,,	$CH_2O_2 + 14CH_2 = C_{15}H_{30}O_2$
Palmitic	,,	$CH_2O_2 + 15CH_2 = C_{16}H_{32}O_2$
Margaric	,,	$CH_2O_2 + 16CH_2 = C_{17}H_{34}O_2$
Stearic	,,	$CH_2O_2 + 17CH_2 = C_{18}H_{36}O_2$
. .	.	.
Cerotic	,,	$CH_2O_2 + 26CH_2 = C_{27}H_{54}O_2$
. .	.	.
Melissic	,,	$CH_2O_2 + 29CH_2 = C_{30}H_{60}O_2$

The action of the acids just examined upon the groups of alcohols previously studied gives rise, as is well known, to the class of bodies called compound ethers. On arranging some of the numerous bodies belonging to this group into a series in which the carbon rises atom by atom, we find, in exact accordance with our former observations, that the accession of one atom of carbon involves the simultaneous introduction of two atoms of hydrogen:—

Increment of Carbon.

Compound Ethers.

Formate of methyl	$C_2H_4O_2$
Formate of ethyl	$C_2H_4O_2 + CH_2 = C_3H_6O_2$
Acetate of ethyl	$C_2H_4O_2 + 2CH_2 = C_4H_8O_2$
Butyrate of methyl	$C_2H_4O_2 + 3CH_2 = C_5H_{10}O_2$
Butyrate of ethyl	$C_2H_4O_2 + 4CH_2 = C_6H_{12}O_2$
Acetate of amyl	$C_2H_4O_2 + 5CH_2 = C_7H_{14}O_2$

All these substances present more or less general interest. The powerful, and in some cases almost repulsive odours which the compound ethers possess may be tamed down by dilution, so as to render these substances useful, and, indeed, extensively applied, substitutes for natural essences. Formate of methyl, the simplest of all compound ethers, like the next term, formate of ethyl, has received some applications in the flavouring of inferior varieties of rum. Acetate of ethyl, familiar to every one as acetic ether, is used for "improving" certain wines; the butyrate of methyl and ethyl, substances which undiluted possess an almost overwhelming, and by no means attractive, odour, exhale, when dissolved in an appropriate amount of spirits of wine, the finest perfume of the pine-apple; acetate of amyl, lastly, the final term of our series, exhibits the peculiar aroma of the jargonelle pear in so high a degree that it is now extensively manufactured to flavour the well-known pear drops of our confectioners.

I must not, however, dilate too much on the odoriferous qualities of the compound ethers; here, indeed, we are concerned with these substances only in so far as they afford additional evidence in favour of our speculations respecting the growth of carbon in a series of carbon compounds.

One more illustration, and we shall have done with this part of our inquiry. In a lecture delivered some time ago in this theatre, I had the honour of submitting to the members of the Royal Institution a brief account of Mauve and Magenta, the remarkable coal-derived colouring matters which have sprung from the happy union of industry and science in our times. May I be permitted once more to call your attention for a moment to the group of tinctorial ammonias? Aniline red, or rosaniline, as it is called by chemists, is convertible by certain processes into beautiful violet, and even blue colouring matters. This conversion invariably involves addition of carbon to the molecule of rosaniline. By its conversion into certain varieties of violet, the red fixes six atoms of carbon; by its transition into certain bluish shades, not less than fifteen atoms of carbon are assimilated. In what manner does this increment of carbon affect the amount of hydrogen? Inspection of the diagram teaches us that aniline violet contains 12 = 2 × 6 atoms of hydrogen more than aniline red, and that the transition of red into blue is attended by an accession of as many as 30 = 2 × 15 atoms of hydrogen.

Increment of Carbon.

	Colouring Matters.
Aniline red .	$C_{20}H_{21}N_3O$
Aniline violet .	$C_{20}H_{21}N_3O + 6CH_2 = C_{26}H_{33}N_3O$
Aniline blue .	$C_{20}H_{21}N_3O + 15CH_2 = C_{35}H_{51}N_3O$

(To be continued.)

ACADEMY OF SCIENCES.

September 25.

M. Boussingault presented a memoir "*On the Functions of Leaves.*" Having shown before that pure carbonic oxide is not decomposed by leaves, he now details experiments which prove that the same gas is never decomposed when diluted by some inert gas as hydrogen. This inertness of carbonic oxide with regard to the green parts of leaves the author takes as a corroboration of the opinion which supposes that leaves simultaneously decompose water and carbonic acid, the latter being transformed into carbonic oxide: $CO_2,HO = CO,H,O_2,CO,H$ expressing the relation in which carbon is associated with the elements of water in cellulose, starch, and sugar—that is, in the principles elaborated by leaves, and whose composition is represented by carbon and water. Further, the author states that the decomposition of water by leaves is no longer an hypothesis. He has established the fact by the analysis of plants grown in an utterly sterile soil under the influence of carbonic acid and water alone. He then proceeds to show that there is a limit to the decomposition of carbonic acid by leaves. A square centimetre of leaves exposed to sunlight for nine hours decomposes 1·14 cc. of carbonic acid. A perfectly dry leaf loses its power of decomposing carbonic acid, and that power can never be restored. The vegetable cell, therefore, offers a striking contrast to the animal cell, since dried infusoria are restored to vitality by moisture. The leaf once dried, its vitality is destroyed for ever. There is nothing like latent existence.

M. Payen made another communication "*On Iodide of Potassium,*" in which he showed that the starch granules swollen under the influence of the neutral iodide are coloured an intense violet by a slight excess of iodine. Under the influence of this agent, the granules seem to contract, separate as flocculi, and fall to the bottom of the vessel. A curious fact pointed out by the author is, that, on crystallising a solution of iodide of potassium containing a slight excess of iodine, the whole of the latter is taken out by the crystals, the mother-liquor containing none.

M. Gal presented a note entitled "*Researches on the Cyanic Ethers.*" By passing a current of dry hydrochloric acid into perfectly dry cyanic ether (Wurtz's), the author obtained a simple combination of the two bodies. It is a colourless liquid at ordinary temperatures, has a piquant smell, fumes slightly in contact with moist air, and slowly becomes a white crystalline mass. On adding a few drops of water to the liquid, the temperature soon begins to rise, and carbonic acid is evolved. If only a very small quantity of water is added, and the tube is cooled, the mixture becomes solid. Treated with more water the solid mass dissolves, and the solution gives a yellow precipitate with bichloride of platinum. Analysis shows that this precipitate is a double chloride of platinum and ethylammonium. The above mentioned solid compound is therefore chloride of ethylammonium, C_4H_7N,HCl. Hydrobromic acid gives a corresponding compound. Both this and the hydrochloric compound with cyanic ether decompose when heated in sealed tubes; hydrochloric and hydrobromic acids escape when the tubes are broken, and a crystalline body remains behind, which is cyanuric ether.

The author next studied the action of the hydracids on the cyanic ether obtained by M. Cloez by the reaction chloride of cyanogen on ethylate of soda. This body, although isomeric with the ether employed in the above experiments, differs from it in all other respects. With dry hydrochloric acid it furnishes chloride of ethyl and cyanuric acid, and with hydrobromic acid undergoes a corresponding splitting up.

The author regards this latter as pure cyanic ether, and writes its formula—

$$\left.\begin{matrix} C_4H_5 \\ C_2N \end{matrix}\right\} O_2.$$

The properties of the former (obtained by the reaction of sulphovinate and cyanate of potash) seem to show that it is a derivative of ammonia, and its composition may be represented by the formula—

$$N \left\{\begin{matrix} C_2O \\ C_4H_5. \end{matrix}\right.$$

NOTICES OF BOOKS.

Journal für Praktische Chemie. No. 13. 1865.

It is sufficient to say of this number that it contains no communication of interest of which some account has not already been given in the Chemical News.

Chemisches Central Blatt. No. 43. 1865.

The numbers of this periodical of late have been destitute of novelties of interest; but in this number we notice a communication by Professor Städeler, entitled "*A Contribution to the Knowledge of Aniline Colours,*" in which he shows that it is possible to produce *true* aniline dyes; that is, dyes from aniline without intervention of toluidine. We shall shortly give an account of the author's experiments.

Death of Professor Beaumert.—We regret to announce the recent decease of the above eminent chemist, whose name will be remembered in connection with the early history of ozone. The experiments by which he attempted to prove that ozone was an oxide of hydrogen higher than the binoxide, although not generally accepted, showed great ingenuity, combined with much philosophical acumen.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

1884. G. Nimmo, Jersey, New Jersey, U.S.A., "Improvements in the manufacture of pots and crucibles wherein metals and other materials may be heated or melted."—Petition recorded July 19, 1865.

2008. J. W. Perkins, Norfolk Street, Strand, "Improvements in the treatment of hydrocarbon or paraffine oils."—August 3, 1865.

2307. W. Unwin, Sheffield, "Improvements in the manufacture of iron."—September 9, 1865.

INVENTION PROTECTED BY THE DEPOSIT OF A COMPLETE SPECIFICATION.

2436. T. V. Lee, Macclesfield, Cheshire, "Improvements in preparing turf for fire-lights and fuel, and for machinery to be employed therein."—Recorded September 23, 1865.

NOTICES TO PROCEED.

1349. H. A. Bonneville, Rue du Mont Thabor, Paris, "Improvements in hydrometers for ascertaining the strength of spirits and the specific gravity of fluids."—A communication from C. A. Valsou, Rue de Ponthieu, Paris.—Petition recorded May 15, 1865.

MISCELLANEOUS.

Money Grants of the British Association.—The following are the only grants made by the British Association for chemical investigations:—Mr. Fairley, polycyanides of organic radicles, 20*l.*; Dr. Matthiessen, cast iron (renewed), 50*l.* Those made for geological observations (which involve, we imagine, agreeable trips on the part of the observers) amount to 415*l.*, and those for zoology, botany, and physiology amount to 340*l.* The amount granted for Kew Observatory is only 600*l.*, a miserable sum when the work done there is taken into account. Some of the grants, we think, might reasonably have been withheld, and the money better applied in improving the salaries of the Kew officials.

Pharaoh's Serpents.—The following account of the curious experiment mentioned by our Paris correspondent last week is contributed to the *Pharmaceutical Journal* by Mr. C. H. Wood:—"A very curious toy is now being sold in Paris, under the name of Pharaoh's Serpent. As this toy really constitutes an interesting chemical experiment, perhaps an account of it may prove interesting to your readers. It consists of a little cone of tinfoil, containing a white powder, about an inch in height, and resembling a pastille. This cone is to be lighted at its apex, when there immediately begins issuing from it a thick, serpent-like coil, which continues twisting and increasing in length to an almost incredible extent. The quantity of matter thus produced is truly marvellous, especially as the coil which so exudes is solid, and may be handled, although, of course, it is extremely light and somewhat fragile. Having a little of the white powder, with which the cones are filled, placed at my disposal by a friend, I submitted it to analysis, and found it to consist of sulphocyanide of mercury. This salt, when heated to a temperature below redness, undergoes decomposition, swelling or growing in size in a most remarkable manner, and producing a mixture of mellon (a compound of carbon and nitrogen), with a little sulphide of mercury. The resulting mass often assumes a most fantastic shape, and is sufficiently coherent to retain its form; it presents a yellow colour on the exterior, but is black within. The 'serpent' shape, of course, results from the salt being burnt in a cone of tinfoil. Both the mercurous and mercuric sulphocyanides decompose in the same manner; but the mercuric salt, containing more sulphocyanogen, seems capable of furnishing a larger quantity of mellon, and is the one used in the French serpents. A solution of pernitrate of mercury is readily precipitated by sulphocyanide of ammonium, and the mercuric sulphocyanide may be easily so prepared. It is best to use the mercurial solution as strong as possible, and to keep it in excess throughout the precipitation. Solution of perchloride of mercury is not so easily precipitated as the pernitrate, probably owing to the solubility of the mercuric sulphocyanide in the chlorides. Perhaps I may be excused for adding that sulphocyanide of ammonium, suitable for the above purpose, may be very easily and economically prepared as follows:—One volume of bisulphide of carbon, four volumes of liq. ammon. fort., and four volumes of methylated spirit are put into a large bottle, and the mixture frequently shaken. In the course of one or two hours, the sulphide of carbon will have entirely dissolved in the ammoniacal liquid, forming a deep red solution. When this result is attained, the liquid is boiled until the red colour disappears, and is replaced by light yellow. The solution is then evaporated at a very gentle heat (about 80° or 90° F.) until it crystallises, or just to dryness. The product is sulphocyanide of ammonium, sufficiently pure for the above purpose. One recrystallisation from alcohol will render it quite white. One ounce of bisulphide of carbon yields by this process exactly one ounce of sulphocyanide of ammonium."

Industries of Birmingham and its Neighbourhood.—Following the example set at Newcastle, some Birmingham gentlemen are about to publish a series of reports on their local industries. The volume, it is said, will include reports prepared by gentlemen whose abilities and experience in their various departments will give the work an official and authoritative value as a record of the history and progress of the multifarious trades of Birmingham and the district. The manufacture of brass-foundry, buttons, boilers, bedsteads (iron and brass), cables, chandeliers, coins, medals, and dies; electro-plate, gas fittings, glass (crown, flint, and stained), guns and pistols, hinges, japan ware, jewellery, nails (cut and wrought), needles, nuts and bolts, optical instruments, paper, papier maché, pins and needles, railway carriages, rules, saddlery, saws, steel pens, surgical instruments, tin plate goods, wire, wire working, wood screws, and many more of the infinitely varied trades will be fully described. The South Staffordshire district will be reported on by a local committee appointed for the purpose, and the report will include an account of the coalfield, and its probable extent and duration, by Mr. J. Beete Jukes, the statistics of the iron and coal trades, and a history and description of the manufactures of the principal towns of the "Black Country;" forming a complete and detailed account of the vast resources and varied products of the Midland hardware towns. Some account of the North Staffordshire iron trade, of the products of Stourbridge, Kidderminster, Redditch, and Coventry, will also be included in the work, which will show the enormous extent, varieties, and excellence of the products of the district described.

ANSWERS TO CORRESPONDENTS.

E. M. W.—We have no faith in our correspondent's disinfectant. His chemistry is decidedly at fault.

Books Received.—"Quarterly Journal of Microscopical Science;" "Ophthalmic Review;" "Scientific Review;" "Dictionary of Chemistry," Part XXXI. Phenol—Phenylamines.

Received.—"Thallium;" T. Fairley; 99.

Errata.—Page 148, second column, *for*

$$\frac{(\text{NaCl} - 68{\cdot}82) + 100}{15{\cdot}96} = x$$

read

$$\frac{(\text{NaCl} - 68{\cdot}82) \times 100}{15{\cdot}96} = x$$

Also *for*

$$\frac{(84{\cdot}78 - \text{NaCl}) + 100}{15{\cdot}96} = x$$

read

$$\frac{(84{\cdot}78 - \text{NaCl}) \times 100}{15{\cdot}96}$$

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Note on Zirconium, by Dr. T. L. Phipson.

After having found that magnesium heated to fusion in close vessels with the acids silicic, boracic, and carbonic, liberated the radicals of these acids, I thought that zirconium might be prepared in the same manner; for many facts show a great analogy between this body and silicium. In 1863 I had not enough of pure zirconia to make the experiments in a conclusive manner. Since then I have prepared a certain quantity with the zirconian syenite of Norway. I obtain thus a zirconia containing about 2 per cent. of yttria. On repeating the experiment I found that oxide of zirconium is reduced as easily as silicic acid or boracic acid, under the influence of magnesium. The reduction takes place at the moment the magnesium begins to melt, and zirconium is obtained in form of a velvety black powder. Dilute hydrochloric acid dissolves the whole of the magnesia formed.

In this manner one can easily obtain large quantities of amorphous zirconium. I have also reduced titanic acid. But whilst silicium and titanium (in some of my experiments) can form gases on combining with hydrogen, boron and zirconium do not. The five bodies carbon, boron, zirconium, silicium, and titanium, form evidently a group of very similar elements.—*Cosmos.*

What are the Source, Annual Yield, and Characteristics of the so-called Volcanic Ammonia? by Mr.* W. D. Howard.

THERE is no difficulty in giving the requested information[illegible] the source and characteristics of the ammonia; the[illegible] yield is not so easily arrived at. However, wh[illegible] information I can give is very much at the ser[illegible]f the Pharmaceutical Conference.

To [illegible]egin, then, with the source. Almost any chemical handbook will show that the proprietor of those marvellous geological riddles, the boracic acid lagoons of Tuscany, does not succeed in preparing from the waters of the lagoons his acid in a state of purity. In commerce it always appears containing from 13 to 20 per cent. of impurities, besides adherent moisture. Conspicuous among these stand various double salts of ammonia, notably the double sulphate of magnesia and ammonia, and from these the ammonia is derived by a very simple process—viz., the double decomposition which ensues when the soda ash is added to the rough boracic acid in the manufacture of borax. The carbonate of ammonia escapes with the carbonic acid and steam, and is easily condensed by a suitable apparatus. After a second purification it takes the form which is tolerably familiar to the members of the Conference.

To illustrate the subject, I give analyses made of an average of the greater part of the boracic acid imported in each of the years 1858 to 1863 inclusive, representing 9307 casks. As every one of the casks was sampled, and special pains were taken that the annual average should not belie its name, the analyses may be fairly considered to represent the actual yield of the lagoons in those years. Further to ensure accuracy, larger quantities than customary were used in the analyses, as much as 500 grains being generally employed, and some of the more minute constituents being determined on twice that quantity. The average of 1862, which represented 2206 casks, was specially examined for rare earths, but without success. By operating on 5000 grains I obtained traces of phosphate of alumina, phosphate of lime, strontia, and a minute trace of arsenic. No trace could be found of nitric acid, boracic acid combined with a base, nickel, cobalt, zinc, uranium, selenium, or lithia.

The peculiar odour of crude boracic acid appears to me to be due to the organic matter soluble in alcohol. This body is probably connected with the gaseous hydrocarbon mentioned as found in the vapours of the Suffioni in Watts's "Dictionary of Chemistry," fol. 636.

	1858	1859	1860	1861	1862	1863
Crystallised boracic acid .	83·305	83·54	83·10	84·15	81·752	82·590
Double sulphate of magnesia and ammonia .	6·479	5·81	5·58	4·86	7·596	6·696
Double sulphate of manganese and ammonia .	·515	1·03	·62	·90	·312	·512
Double sulphate of soda and ammonia . . .	1·474	1·66	1·88	1·59	4·470	2·573
Ammonia alum . . .	·180	·21	trace	·07	absent	absent
Sulphate of ammonia .	3·579	3·01	3·58	3·88	2·437	2·815
Chloride of ammonium .	·110	·03	·06	·06	·080	·075
Sulphate of lime . .	·706	·86	·89	·79	·628	·796
Sulphate of potash . .	·196	·45	·29	·43	·351	·396
Persulphate of iron and iron alum . . .	·095	·19	·20	·25	·256	·216
Silica and alumina . .	·839	·90	1·06	1·00	·957	·958
Peroxide of iron . .	·084	·06	·02	·08	·043	·070
Sulphur	traces	traces	·04	traces	·035	·020
Free sulphuric acid . .	·050	·03	·12	·16	·007	·008
Organic matter soluble in alcohol	·332	·50	·49	·32	·106	·265
Organic matter insoluble in alcohol . . .	·301	·92	·54	·06	·200	·130
Moisture	1·755	·80	1·53	1·40	·770	1·880
	100·000	100·00	100·00	100·00	100·000	100·00

The only characteristic of the ammonia derived from this source that I am aware of is its perfect purity and freedom from all those minute traces of evil-smelling compounds with which both that made from gas liquor and from bones is so liable to be tainted.

The annual yield of the lagoons is, as I previously stated, an almost impossible problem. Doubtless the amount of ammonia arriving in this country in the boracic acid is a very small amount in comparison with that which is yearly run away in the mother liquors. Nor do I think that there would be a profit on collecting it, as the price it would fetch in this market would hardly do more than cover the expenses of transit.

On the Action of Light upon Sulphide of Lead, and its bearing upon the Preservation of Paintings in Picture Galleries, by Dr. D. S. Price.†

The author's attention was directed to this subject by observing that in the cases in the South Kensington Museum, which are painted with white lead, that substances which emitted sulphurous vapours did not cause a darkening of the surface of the case, excepting where it was protected from the direct influence of light. A number of experiments was then tried as to the action of light upon sulphide of lead produced by the action of sulphuretted hydrogen upon lead paint. A board painted white with white lead was exposed for several hours to the action of sulphuretted hydrogen, until the surface had acquired a uniform brown colour. Plates of glass of different colours were then placed upon the painted surface, one portion being at the same time covered with an opaque medium, and another left entirely exposed. The board was then placed facing the light. The glasses employed were red, blue, yellow (silver), violet, and

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* Read at the meeting of the Pharmaceutical Conference.

† Read at the meeting of the British Association.

smoke-colour glass. The results exhibited were after an exposure of eight days, and showed that the parts of the board directly exposed to light were bleached; those protected by an opaque medium were not acted upon; while with the glasses of different colours intermediate effects were produced, those of the violet glass being most decided. Drying oils in conjunction with light rapidly bleach sulphide of lead, and boiled oil effects the bleaching still more rapidly. When water colour is used bleaching takes place, but much more slowly than in the case of oil. After quoting authorities, stating that generally light was advantageous to the preservation of pictures, Dr. Price showed a striking illustration of this fact. He had a picture painted, and then exposed it to the action of sulphuretted hydrogen, until it became sadly discoloured, and to all appearance destroyed. Some strips of paper were laid across the picture, so as to cover some parts. The picture, thus partially covered, was exposed to light for a long time. The result, as shown at the meeting, was very curious indeed, the parts of the picture exposed being perfectly restored, while those protected by the paper remained still discoloured. From his experiments he came to the conclusion that it was advantageous to have picture galleries well lighted, especially where, as in towns, the atmosphere was charged with sulphur compounds, and that it was quite a mistake to have curtains placed in front of pictures, with a view to their protection. In the course of his communication Dr. Price referred to the use of zinc paint for houses, and considered it likely to be acted upon, as the paint was rendered soluble by the acids contained in the atmosphere of towns.

Compounds of Copper and Phosphorus, by Mr. F. A. ABEL.*

THIS paper was devoted to the description of a series of experiments made to ascertain if phosphorised copper would be more effectual as a material for the manufacture of cannon than the alloy now in general use. After referring to the different chemical compounds of copper and phosphorus known, Mr. Abel spoke of his experiments on phosphorised copper, with respect to its tensile strength. He found that an ingot of copper one inch in area broke under a strain of about 25,000 lbs., that of a similar ingot of gun metal required 32,000 lbs. Whilst copper combined with ·5 per cent. of phosphorus required 38,389 lbs., and with 1·4 per cent. of phosphorus the strain that the ingot would bear was upwards of 47,000 lbs. Although these experiments showed the very superior tenacity of the phosphorised copper, yet there were practical difficulties which prevented the application of this compound to gunnery. In the course of the discussion which followed the reading of this paper, Mr. Abel stated that this phosphorised copper would not be at all suitable for telegraphic purposes, as the presence of phosphorus was most detrimental to the metal as a conductor of electricity.

After the paper of which the above is an abstract had been read, Mr. A. W. Wills made the following statement:—

So long ago as 1848 a patent was taken out by Mr. Alexander Parkes, of Birmingham, for the use of compounds of copper, zinc, nickel, and other metals, with phosphorus. The result of Mr. Parkes' experiments, more especially with respect to the copper compounds, had been so favourable as to enable him to claim for them many advantages—especially as regards the tenacity, hardness, and homogeneous character of the metal produced. This he proposed to apply to the manufacture of tubes, sheathing, cylinders for calico printers, and manifold other purposes.

Since the date above mentioned, Mr. Parkes has obtained other patents for modifications and improvements in his original process, and the manufacture of phosphorised copper, containing from $\frac{1}{8}$ to $\frac{1}{2}$ per cent. of phosphorus, is now successfully carried on at the extensive works of the Stephenson Tube Company, in Birmingham, with which the patentee is connected.

This metal is forged, drawn, and rolled both hot and cold, and its successful application to the manufacture of tubes, cylinders, sheets, and various other purposes, has established its claim to the possession of those qualities which are stated by Mr. Parkes to be its especial characteristics—viz., great hardness, homogeneousness, smoothness and evenness of texture, and tenacity. Its employment for the manufacture of large cylinders for calico printing has been especially satisfactory, by reason of these qualities.

The successful issue of the whole manufacture appears, however, to depend upon the careful selection of materials, and upon certain niceties of manipulation, which are absolutely indispensable.

PHYSICAL SCIENCE.

Notes on the Fracture of Polished Glass Surfaces, by F. H. WENHAM.†

THE short communication which I submit to your notice scarcely merits consideration as a discovery; but as the microscope has in this case immediately detected the cause of a well-known phenomenon, I bring it forward as an example of the use of the instrument i[illegible]cal investigations.

It is a fact known to the philosophical instrument makers that if a metal wire be drawn through [illegible] glass tube, a few hours afterwards the tube will burst into fragments. The annealed glass tubes used for the water-gauges of steam-boilers are sometimes destroyed in this way, after the act of forcing a piece of cotton waste through them with a wire for the purpose of cleaning the bore. This will not happen if a piece of soft wood is employed.

The late Andrew Ross informed me that on one occasion, late in the evening, he lightly pushed a piece of cotton wool through a number of barometer-tubes with a piece of cane, for the purpose of clearing out any particles of dust. The next morning he found most of the tubes broken up into small fragments, the hard siliceous coating of the cane proving as destructive as he had previously known a wire to be.

After having drawn the point of a steel burnisher over the surface of a slip of polished glass, the following appearances will be observed under the microscope, using the polarising apparatus and selenite plate, with a two-thirds object-glass. A coloured stripe is visible in the passage of the burnisher, showing that the surface of the glass has been placed in a state of tension in the direction of the line. The glass, too, seems not altogether devoid of plasticity, for the waves of colour show that it has been carried forward in ripples, resembling the mark left on a leather-bound book after the passage of a blunt point. It may be inferred from this that the mere burnishing of the surface of the glass

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* Read at the meeting of the British Association.

† Read before the Microscopical Society.

with a substance inferior in hardness will, without any scratching, cause an irregular strain in the bore of tubes sufficient to split them, and the concussion attendant upon the fracture often reduces the tube to small fragments.

If the burnished lines upon the glass slip be examined a few days afterwards, the colours will have become much less visible, showing that the strained portions of the glass partly recovers its equilibrium.

On attempting to polish out a minute scratch on the surface of a piece of glass, it sometimes appears to widen during the process, and at length resolves itself into two irregular parallel rows. Also, a clean cut made with a diamond on a piece of plate-glass, if left for a time, the surface in the vicinity of the cut will break up, forming a coarse irregular line. If the diamond be raised and struck lightly on the surface of the glass, the form of the edges of the short stroke thus made may be plainly seen, using the binocular polariscope. A conical ridge of glass appears to be left with its apex under the line of the cut, and the glass is frequently wedged up on both sides of the ridge, explaining the cause of the double line of fracture which sometimes makes its appearance in polishing out a scratch. This effect may also be exemplified by observing the marks left on a polished glass surface from the light blows of a steel centre-punch. The point of the punch drives in an atom of the glass, and the fracture extends some distance into the interior, expanding downwards in the form of a truncated cone. The polariscope shows that the conical centre is in a state of compression, and that the surrounding exterior portion of the glass is also under strain.

The smooth, round edge of a glazier's diamond, when drawn over a polished glass surface, burnishes down and [illegible]presses the glass beneath the cut, and in the ca[illegible]hin sheets the wedge-like force of the compr[illegible]ine splits the glass nearly through; but when th[illegible]ass is thick and rigid, as plate-glass, unless the shee[illegible]s bent back and broken through immediately after the cut, greater difficulty will be experienced if allowed to remain for a time, for the compressed line of glass will speedily tear up the portion on both sides, leaving a wide ragged groove in place of the original clean and scarcely visible line.

THE EXCISE LABORATORY.

REPORT FROM THE PRINCIPAL TO THE COMMISSIONERS OF THE INLAND REVENUE, 1865.

In my last Report I alluded to the fact that, owing to recent legislation, the business of the laboratory had altered considerably in character, and that, although the aggregate number of samples examined during the year was much less than the number examined in the previous year, the amount of work performed was much greater. In reverting to this subject, at the risk of being charged with giving undue prominence to it, I am actuated solely by a desire to show that the operations of my department, as subsidiary to a highly organised system of levying and securing a large revenue, have not lessened, but are steadily increasing in importance. That this should be the case is not surprising, as the invention and adroitness brought to bear on the acquisition of wealth are daily becoming more refined, and more adopted by enterprising persons. Occasionally bold attempts are made to circumvent the revenue under the guise of new and legitimate objects of trade, whilst it not infrequently happens that complaints are made that the existing fiscal restrictions imposed on the production and assessment of dutiable commodities are unnecessarily stringent, and that a relaxation of such restrictions might safely be allowed. Some of these complaints are, no doubt, well founded and deserving of serious attention, but others are insidious, and the pleas upon which they are based require to be examined with the utmost care, under the guidance of the laws and regulations relating to the collection of the revenue, and also by scientific investigations of the modified processes which may be proposed as beneficial to trade, but which, if sanctioned, might lead to frauds on the revenue. Thus, the number of samples analysed does not give a full idea of the extent of the business of the laboratory, as the researches and investigations undertaken for special objects, and which demand much time and thought, are not included. As an instance, it may be proper to mention the following case, which is now depending:—The hop planters of Kent, being desirous to avail themselves of duty-free tobacco for the purpose of destroying the insects which infest the hop plant, memorialised Government on the subject, and the question being submitted to me, a series of experiments were at once commenced to discover some mode by which the extract of tobacco intended to be used might be rendered unfit for the purposes of fraudulent tobacco manufacturers, without causing it to be injurious to the hop plant. The problem may appear simple, but it was soon found to be very difficult of solution, and all the substances hitherto tried, which, when added to the tobacco extract, could not again be separated effectually, and which would prevent an improper use of such extract, have proved to be injurious to vegetation. Experiments are still going on, and I hope to be able soon to surmount the difficulty.

During the last financial year the Act allowing duty-free malt to be used in the feeding of animals came into operation, and up to March 31 last 519 samples of mixtures of malt and linseed prepared for the purpose mentioned, and 365 samples of ground linseed alone, had been examined in the laboratory; and it is satisfactory to be able to state that, with two or three exceptions, the whole of the samples were found to be totally unfit for the brewing of beer, thus proving that the revenue derived from malt is not, as it was by some feared it would be, endangered under the provisions of the Act in question.

The stringent measures adopted by the Customs to prevent the importation of simulated wines are still continued, and 182 samples have within the year been examined, of which 102 were found to be composed chiefly of factitious wine, whilst nearly the whole of the remaining 70 were of very low value, and, although genuine wine predominated more or less in their composition, they still contained considerable proportions of spurious wine. There can be no doubt but that these made-up liquids would, but for the energetical action of the Customs, have passed into consumption either *per se* as sherry, or mixed with genuine wine.

Within the past year two manufactories have been established in London for the purpose of preparing glucose or starch sugar for the use of brewers, and as this sugar differs considerably both in value and character from cane sugar, to which alone the existing rates of duty apply, it has become necessary, for the purposes of assessment, to determine the ratio of dutiable value of the two descriptions of sugar, and for this end 12 samples of glucose have been analysed.

Analyses for the Customs continue to form a considerable proportion of the work devolving on the laboratory, as during the past year no less than 2259 samples were examined for that branch of the revenue.

The progress of the business of the laboratory for the last four years will be seen from the following table, in which the samples of coffee and mixtures of chicory and coffee are distinguished from the other samples :—

Year.	Number of Samples examined excluding Coffee and Chicory, and also those from Customs.	Number of Samples examined.		Total Number of Samples examined.	Increase.	Decrease.
		Coffee and Mixtures of Chicory and Coffee.	From the Customs.			
1861	8364	3045	22	11431	—	—
1862	6251	5088	21	11360	—	71
1863	6309	25	2254	8588	—	2772
1864	8388	61	2259	10708	2120	—

Thus, during the period to which the above table refers no less than 42,000 samples have been analysed, an amount of work the results of which cannot have failed to exercise a beneficial effect not only upon the interests of the revenue, but upon those of the community in general.

In the educational branch of the laboratory ten young officers have, since the date of my last Report, completed a course of study in chemistry, and in their final examination by Dr. Hofmann they acquitted themselves in such a manner as to draw from that gentleman a very high encomium. This satisfactory result is mainly due to the intelligence and assiduity of the students themselves, who, in common with their predecessors, have shown a desire to profit to the utmost by the opportunity afforded them of obtaining scientific knowledge, and have evinced an earnest and praiseworthy determination to merit the approbation of the Board. Fifty-nine students have now passed through a course of education in chemistry, and it is perhaps not too much to say that they form a valuable reserve from which officers may be selected to assist in securing the revenue in those cases in which it may be advantageous to make their scientific knowledge available. At the present time only six students are under instruction, as owing to the limited space at the disposal of the department, and the increase of the practical business of the laboratory, it was found difficult to spare room for more.

During the period to which this Report relates fourteen examiners have received in the laboratory a month's instruction in the modes of detecting the adulteration of articles subject to revenue duties; 170 of these officers, whose position in the service is highly onerous and demands much intelligence and practical knowledge, have passed, on the whole, with great credit through my department.

Tobacco.—The condition of the trade in this important commodity, so far at least as relates to the question of adulteration, continues in a most healthy state; it cannot, of course, be supposed that an article upon which is imposed a duty of about 500 per cent. on its value, should escape the attention of the smuggler or the adulterator, and it can only have been by well-directed and sustained efforts that frauds on the tobacco revenue have been kept down to a minimum which is insignificant when compared with the large yearly duty derived from the article, and the following table may not be uninteresting, as showing that the consumption of duty paid tobacco has more than kept pace with the increase of population in the United Kingdom :—

Year.	Total population of Great Britain, and approximately of Ireland.	Pounds Weight of Tobacco cleared for consumption in the United Kingdom.	Weight of Tobacco yearly consumed per head of the population.	
			lbs.	ozs.
1841 .	26,700,000	23,096,281	0	13¾
1851 .	27,347,000	27,734,786	1	0¼
1861 .	28,887,000	35,413,846	1	3⅝
1863 .	29,195,000	37,636,240	1	4⅝

{ Population estimated according to the percentage increase during the decennial period from 1851 to 1861.

A few cases of the adulteration of tobacco with liquorice have been detected during the past year, but the quantity of liquorice used was very small. In two instances which occurred in London the tobacco contained not more than 1 per cent. of the illicit ingredient. The practice of illegally using liquorice and other saccharine matter still lingers in Ireland, but the numerous detections which were some time ago made, and the penalties imposed, appear to have had a salutary effect, as the fraud, when now committed, seems to be done timidly, and not in that gross and daring manner which was the case when the offenders were under the impression that the Revenue possessed no satisfactory means of proving, by analysis, the commission of the fraud.

As in previous years, I have myself closely inspected a large number of the tobacco manufactories in the kingdom, and I am in a position to say, from my own observation, that the adulteration of tobacco is now almost nominal.

It will be seen from the following table that it has been deemed necessary to examine 158 sample[illegible] a suspicion that they were illicit, but of these onl[illegible]ere adulterated, the most of them to so slight an e[illegible]as to lead to the inference that the object was not s[illegible]ch to defraud the Revenue as to impart a particular cha[illegible]cter to the tobacco :—

Year.	Number of Samples. Genuine.	Adulterated.	Total.
1862. .	56	48	109
1863. .	69	31	100
1864. .	124	34	158

Of the adulterated samples, three contained cane-sugar, four cane-sugar and liquorice, fourteen liquorice, four coltsfoot, one cabbage leaves, two sulphate of iron, one lamp-black; whilst five samples of "fancy tobaccos" contained stramonium, coltsfoot, lavender, and southern-wood.

(To be continued.)

Manufacture of Arsenic Acid.—Girardin suspends powdered arsenious acid in water, and passes chlorine into the mixture, by which he soon obtains a clear solution of arsenic acid in hydrochloric acid. By evaporating this solution a mass of arsenic acid containing no trace of arsenious is procured. As it is difficult to keep any considerable amount of arsenious acid in suspension in water, the author finds it better to make a saturated solution of that acid in hydrochloric, and pass the chlorine into such solution while hot. The stream of chlorine is stopped when a little of the fluid neutralised with potash no longer gives a green precipitate with bichromate of potash, thus showing that all the arsenious acid has been converted. The hydrochloric acid may then be recovered by distillation, and the syrupy solution of arsenic acid left in the retort evaporated.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Weekly Evening Meeting, Friday, April 7.

H.R.H. The Prince of Wales, *Vice-Patron, in the Chair.*

On the Combining Power of Atoms.

By Dr. A. W. Hofmann, *F.R.S.*

(*Continued from page 169.*)

In the preceding remarks, I have submitted to you an extensive series of examples taken from different pages in the vast volume of chemistry, which appear to indicate that oxygen combines atom by atom, that nitrogen enters the compound freighted with one atom of hydrogen, and, lastly, that carbon cannot join the concern except with a capital, so to speak, of two atoms of hydrogen. Supposing, for a moment, that this rule could be established without a single exception throughout the whole range of chemistry; are we enabled to assign a probable reason for this peculiar behaviour of the oxygen, nitrogen, and carbon atoms?

To answer this question we must commence by considering for a few moments some of the simplest compounds of the elements concerned.

Here we have four glass tubes surmounted by large globes. The first of these contains hydrochloric acid, the compound of hydrogen with chlorine; the second did contain the vapour of water,—the compound of hydrogen with oxygen—but which is now condensed to small drops of fluid water deposited on the sides of the globe; in the third vessel we have the compound of hydrogen with nitrogen, ammonia; while the last is filled with one of the compounds of carbon with hydrogen, viz., marsh-gas.

These four compounds, all transparent and colourless, we distinguish by the simplest experiments. On opening the sealed tubes of the vessels under mercury, no change takes place in the case of hydrochloric acid, ammonia, and marsh-gas, while the mercury immediately rises and fills the globe containing the condensed water vapour. When the remaining three vessels are now raised, so as to allow the broken points of the tubes to dip in a layer of water floating on the mercury, the liquid rushes into the globes containing hydrochloric acid and ammonia; of the two solutions thus produced by the absorption of the gases, the one containing the hydrochloric acid reddens blue litmus; the other, formed by the absorption of the ammonia, changes red litmus to blue. The marsh-gas differs from all the others by its insolubility and by its inflammability. Indeed, if the globe be broken and a light applied, the gas burns with a feebly luminous flame.

Nor are the differences observed in the structure of these four hydrogen compounds less characteristic, although they cannot be so easily demonstrated by experiment,—at all events, within the limited time at my disposal. Indeed, to give you an idea of their structure which is necessary for our purposes, I must be permitted to borrow a leaf from the book of the Wizard of the North, and to avail myself of a simple mechanical contrivance devised for that purpose. Let these four tin boxes represent two volumes of hydrochloric acid, water-gas, ammonia, and marsh-gas.

We wish to know the quantities of hydrogen contained in two volumes of each of these four bodies, and we find that out of the two volumes of hydrochloric acid we are enabled to pull one volume of hydrogen; out of the same volume of water-vapour, two volumes of hydrogen; out of the same volume of ammonia, by a mechanical contrivance of the simplest description, three volumes of hydrogen; and, lastly, out of two volumes of marsh-gas, four volumes of hydrogen.

Fig. 1.

We now require to know the quantities of the other elements present in the four compounds under examination, and again we extract from the original two volumes of hydrochloric acid one volume of chlorine; from the two volumes of water-vapour, one of oxygen; from the two of ammonia, one of nitrogen; and, lastly, from the two volumes of marsh-gas, an amount of carbon which provisionally I may be permitted to represent by one volume, since, owing to the non-volatility of the carbon, the volume of the carbon-vapour has not yet been ascertained.

Fig. 2.

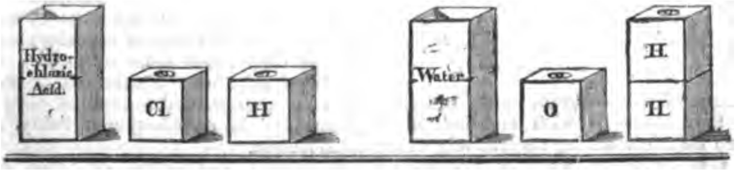
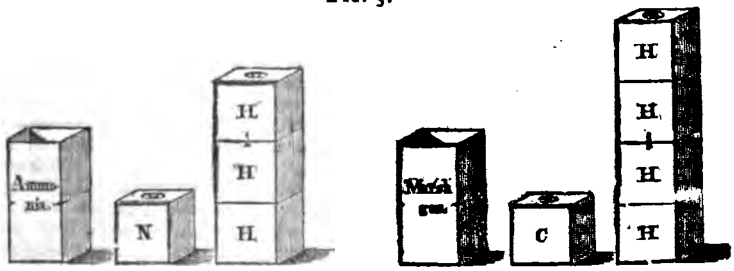
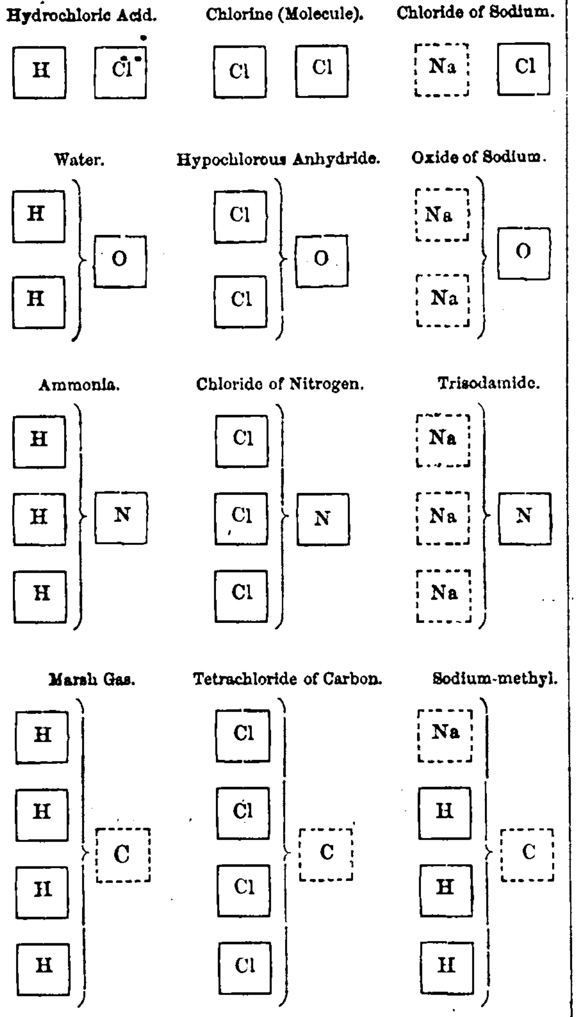


Fig. 3.



The information mechanically conveyed to us by our tin boxes is embodied in the following diagram, which is, moreover, calculated to enlarge our views respecting the combining powers of the elements chlorine, oxygen, nitrogen, and carbon :—

Fig. 4.



In the second column of the diagram are given the compounds of these four elements with chlorine, and exactly as we have seen them combining respectively with 1, 2, 3, and 4 volumes of hydrogen, we now find them associated with 1, 2, 3, and 4 volumes of chlorine. Again, in the third column we have the series of sodium compounds of these elements, and although in this case we must be careful not to speak of volumes of sodium-vapour, since chemists have not as yet obtained sodium-gas in the pure state, we perceive at all events from the diagram that one volume of oxygen fixes exactly twice, one volume of nitrogen exactly three times the quantity of sodium which is combined with one volume of chlorine.

The study of elementary gases has led chemists to the unanimous opinion that equal volumes of these different gases contain an equal number of the smallest particles or atoms. Numerous theoretical considerations and numerous experimental inquiries inevitably lead to this result, which is now a generally received truth. If equal volumes of different gases be submitted to the same pressure they contract to an equal extent, and if they are equally heated they expand equally.

We have an apparatus (Fig. 5) so disposed as to permit us to establish this point experimentally. It consists of a kind of double U tube, with one long and simple limb, and one short limb bifurcated into two branches, each of which is provided with a stopcock. These short limbs are, moreover, surrounded by a glass cylinder. Near the bottom of the apparatus another stopcock is placed, enabling us to empty the apparatus. The three limbs of the instrument being filled with mercury, we introduce into the stopcocked limbs the gases to be examined, into the one hydrogen, and into the other oxygen, care being taken to have as nearly as possible equal volumes of the two. These volumes being marked by caoutchouc rings, we pour mercury into the long open limb, and we find that the mercury column thus obtained compresses the two gases to an exactly equal extent. Again, on letting out mercury through the bottom sropcock, so as to lower the column and diminish the pressure, we observe that both hydrogen and oxygen undergo equal dilatation. And so, again, we are enabled to prove the expansion and contraction of the two gases to be equal, if the glass cylinder surrounding the bifurcated limb of the apparatus be filled alternately by hot steam or cold air.

Now, if equal volumes of the elementary gases contain an equal number of atoms, it is obvious that

The chlorine atom combines with 1 atom of hydrogen,
,, oxygen ,, ,, 2 atoms ,,
,, nitrogen ,, ,, 3 ,, ,,

and since there are reasons for believing that the quantity of carbon existing in two volumes of marsh-gas (but which, as I have pointed out, has never been obtained in the gaseous state) represents the carbon atom, we may add that

The carbon atom combines with 4 atoms of hydrogen.

And in a similar manner we may say that the at[illegible] of the four elements in question, when uniting with c[illegible]ne, are found to be capable of fixing 1, 2, 3, or 4 at[illegible]f chlorine.

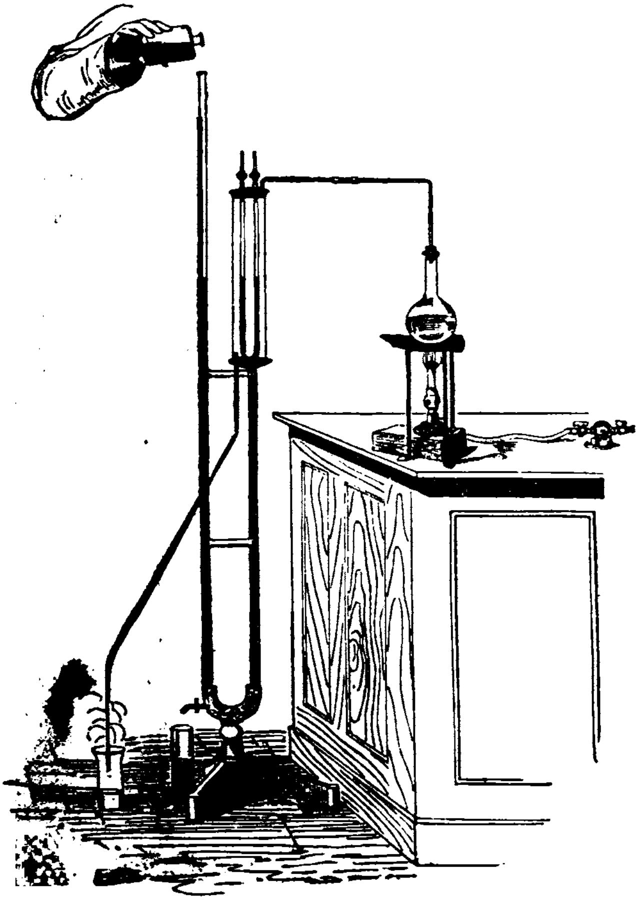
These observations, which, if time permitted, mig[illegible] be considerably expanded, lead us to a very important distinction of elementary atoms, which is based upon their atom-fixing capabilities, more shortly expressed, upon their combining powers.

If the atom-fixing power of the chlorine atom be taken as standard of comparison, we are compelled to assign to the oxygen atom the twofold, to the nitrogen atom the threefold, and to the carbon atom the fourfold atom-fixing power; or, looking at this question from a different point of view, we find that one atom of oxygen is performing the work of two atoms of chlorine; one atom of nitrogen, that of three; one atom of carbon, lastly, that of four atoms of chlorine. Hence we distinguish the chlorine atom as *univalent*, the atom of oxygen as *bivalent*, that of nitrogen as *trivalent*, and, lastly, the carbon atom as *quadrivalent*.

With the recognition of these different combining powers in elementary atoms we have made a very considerable step towards the solution of the question which presented itself in the earlier part of this discourse—viz., How is it that the oxygen atom is fixed directly, the nitrogen atom together with one, the carbon atom, lastly, together, with two atoms of hydrogen? This peculiar mode of combination is the necessary consequence of the special atom-fixing capabilities of the oxygen, nitrogen, and carbon atoms; and this I believe I can show you by a very simple contrivance. I am again tempted to rely entirely on mechanical means of elucidating the subject, and I will on this occasion, with your permission, select my illustration from that most delightful of games, *croquet*.

Let the croquet balls represent our atoms, and let us distinguish the atoms of different elements by different colours. The white balls are hydrogen, the green ones chlorine atoms; the atoms of fiery oxygen are red, those of nitrogen, blue; the carbon atoms, lastly, are naturally represented by black balls. But we have, in addition, to exhibit the different combining powers of these atoms.

FIG. 5.



This we accomplish by screwing into the balls a number of metallic arms (tubes and pins), which correspond respectively to the combining powers of the atoms represented, and which, while constituting an additional feature of distinction, enable us at the same time to join the balls and to rear in this manner a kind of mechanical structure in imitation of the atomic edifices to be illustrated. Thus the hydrogen and chlorine atoms, which are *univalent* atoms, have each *one* arm, representing one combining or attraction unit; the atom of oxygen, a *bivalent* atom, has *two*, representing two attraction units; while the nitrogen and carbon atoms, respectively *trivalent* and *quadrivalent*, are provided with *three* and *four* arms, indicating the three and four combining units respectively distinguishing these atoms.

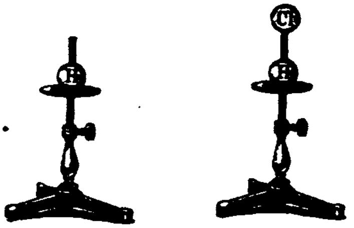
FIG. 6.

Of the newly-formed building materials let us make a preliminary trial in constructing the four hydrogen compounds just examined.

We start with four appropriately disposed stands as a foundation, on each of which we place a hydrogen sphere as the first building stone.

On one of these hydrogen atoms we fix a chlorine atom by inserting the solid arm of the former into the tubular arm of the latter, we have thus constructed a molecule of hydrochloric acid. The attraction units of the two elements are saturated; we can add no more; the building is finished.

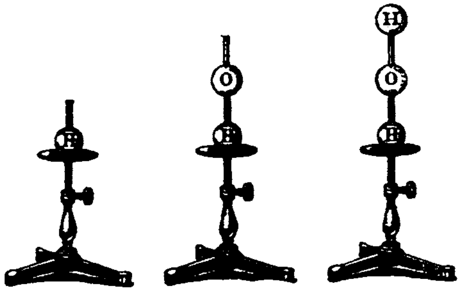
FIG. 7.



Formation of HYDROCHLORIC ACID.

The next hydrogen atom we combine in a similar manner with an atom of oxygen, but no closed molecule is thus produced. One of the attraction units of the oxygen is not yet saturated, as indicated by the one arm remaining uncovered. Only by fixing upon this arm a second hydrogen atom we saturate this second attraction unit also. The closed water molecule is a finished building.

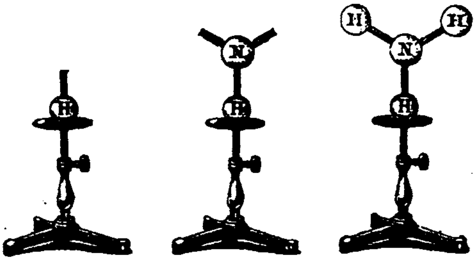
FIG. 8.



Formation of WATER.

Again, an atom of nitrogen is inserted into the hydrogen atom on our third stand; the two nitrogen arms which are left exposed sufficiently indicate that two attraction units remain unsaturated, and have accordingly to be provided with two atoms of an univalent element. If this univalent element be hydrogen, the finished structure is the molecule of ammonia.

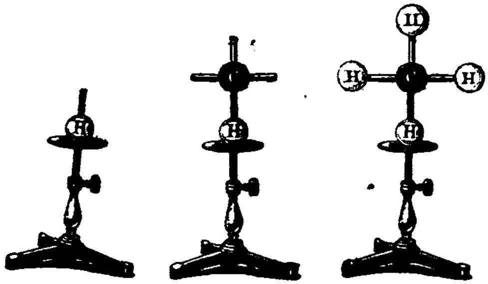
FIG. 9.



Formation of AMMONIA.

In a similar manner, lastly, we perceive that when a four-armed carbon atom is fixed upon the hydrogen atom, the three combining units remain unsaturated, and that the construction of a closed molecule of marsh-gas can be accomplished only by the accession of three atoms of hydrogen.

Fig. 10.



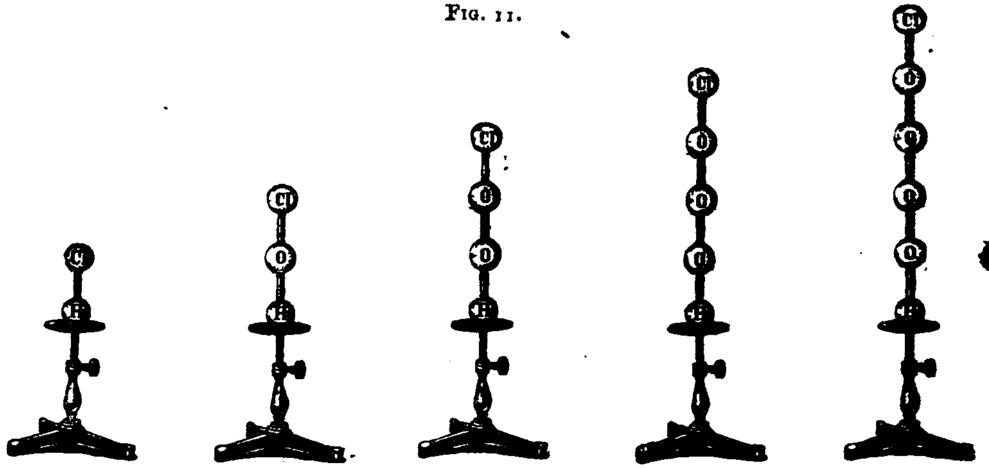
Formation of Marsh-gas.

At this stage we may appropriately resume the question suggested by the earlier considerations of this evening. The facility with which our newly-acquired building material may be handled enables us to construct even some of the more complicated substances involved in these considerations.

And, first, the building up of the oxygen compounds of hydrochloric acid may be attempted. On opening the molecule of hydrochloric acid, two attraction units (one belonging to the hydrogen atom, and the other to the chlorine atom), are liberated; they are exactly equal to the two attractions of the bivalent atom of oxygen. With the insertion of an oxygen atom, we perceive that the molecule is closed again; no uncovered arm projects, no attraction remains unbalanced. This new molecule—we call it hypochlorous acid—we open again; again two attraction units are liberated and saturated by a second atom of bivalent oxygen. The molecule of hypochlorous acid is thus converted into the molecule of chlorous acid. The insertion of one or two more oxygen atoms under exactly similar circumstances would give rise to the formation of the molecules respectively of chloric and of perchloric acids.

We are thus enabled, by availing ourselves exclusively of oxygen as building material, to convert the two-storied molecule of hydrochloric acid successively into a three-, four-, five-storied molecule, and ultimately even into the six-storied molecule of perchloric acid; and there is no reason why a happy experimentalist, by using additional and more complicated scaffolding, should not succeed in raising still loftier structures.

Fig. 11.



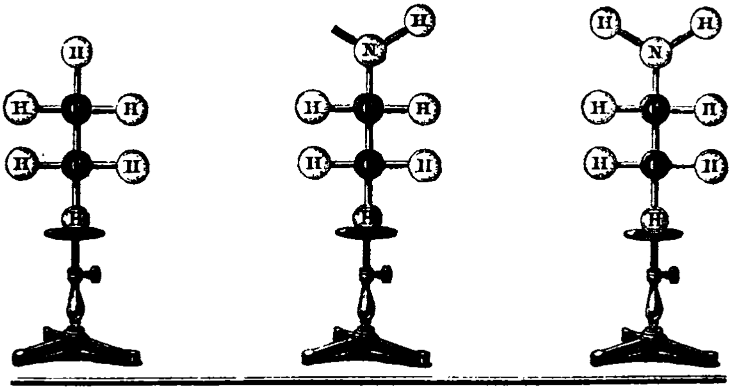
Hydrochloric Acid. Hypochlorous Acid. Chlorous Acid. Chloric Acid. Perchloric Acid.

The reason why, when uniting with a compound, oxygen joins this compound, atom by atom, is now obvious. By opening a finished molecule, two attraction units are set free; these may be balanced by one atom of oxygen, but also by a chain of two, three, four,—in fact, of any number of oxygen atoms. Of the two, four, six, eight, &c. attraction units possessed by one, two, three, and four atoms of oxygen, two, four, and six units are consumed in linking these atoms into a chain, so that only two units—one at each end of the chain—remain at our disposal, and may be used in closing up again the broken molecule.

Not less satisfactory is the information supplied by the consideration of a series of nitrogenetted compounds. In hydride of ethyl we possess a molecule containing two atoms of carbon and six atoms of hydrogen. With the view of introducing an atom of nitrogen, we break this molecule. A glance at our model (Fig. 12) shows us at once that, by inserting between the fragments a nitrogen atom only, we are unable to reproduce a finished building, for of the three attraction units with which the nitrogen atom enters, two only are saturated; one remains unsaturated; indeed, one nitrogen arm projects uncovered. It is only by addition of another atom of hydrogen that the closed molecule of ethylamine is formed. This molecule again we open, again we introduce an atom of nitrogen, and again we observe that one attraction unit of the newly-added atom remains unsatisfied, and that an additional atom of hydrogen is required for the transformation of ethylamine into ethylene-diamine, and so again when ethylene-diamine is to be converted into vinyltriamine (Figs. 13 and 14).

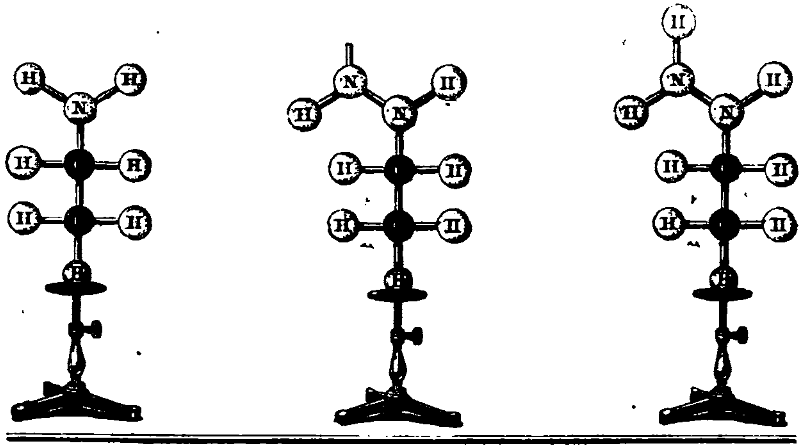
Why the nitrogen atom does not combine directly, like the atom of oxygen, but always carries an atom of hydrogen along with it, is now likewise demonstrated. If a finished molecule be broken for the reception of a new atom, the number of combining units liberated is always two. This, as we have seen, is the number which is saturated by one atom of oxygen, or by a chain of oxygen atoms; but when these two attraction units are saturated by a nitrogen atom, one of the attraction units of the nitrogen remains free; when they are saturated by a chain of nitrogen atoms, the number of attraction units remaining free must be equal to the number of atoms composing the nitrogen chain.

FIG. 12.



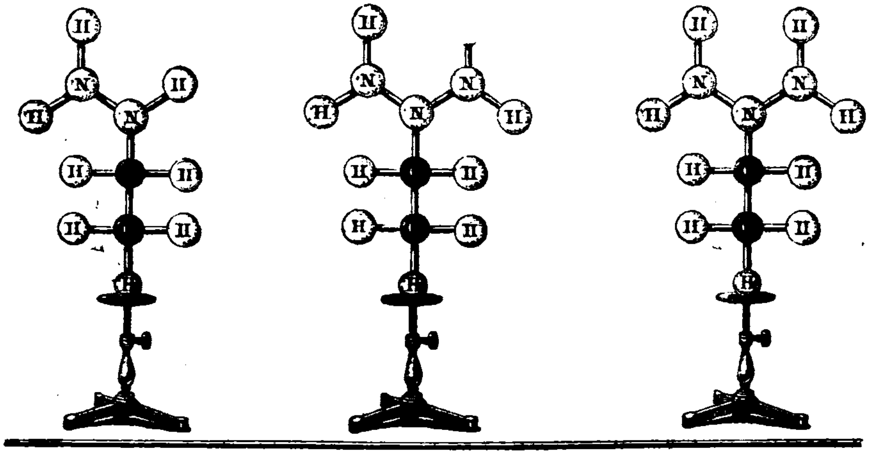
HYDRIDE OF ETHYL. ETHYLAMINE.

FIG. 13.



ETHYLAMINE. ETHYLENE-DIAMINE.

FIG. 14.



ETHYLENE-DIAMINE. VINYLTRIAMINE.

To be continued.)

ACADEMY OF SCIENCES.

October 2.

The only chemical paper read was by M. E. Kopp, "*On the Utilisation of Soda Waste, and the Residues of the Manufacture of Chlorine.*" All the ideas in this paper are old, and most of them will be found in Dr. Hofmann's Exhibition Report, pp. 32-33. The author's present method of proceeding is as follows:—He takes the acid residual liquor obtained in the manufacture of chloride of lime, allows the solid matters to deposit, and then adds just enough soda waste to destroy the free chlorine and convert the per- and sesqui-chlorides of iron and manganese into protochlorides. Some sulphur is separated, which may be collected, and some sulphuretted hydrogen is evolved, which may be absorbed by ferric oxide. The dechlorinated, but still acid liquor is now pumped into a special apparatus, in which it is completely saturated with soda waste. A large amount of sulphuretted hydrogen is then evolved, and may be burned so as to produce either water and sulphur, or water and sulphurous acid. The author gives another process for the utilisation of soda waste. When the waste is exposed to the air, M. Kopp has found that the oxy-sulphide of calcium ($2CaS,CaO$) changes into bisulphide of calcium and quicklime. By further oxidation the bisulphide is transformed into calcic hyposulphite, which, on drying, becomes converted into calcic sulphite and free sulphur. The calcic sulphite is soon further oxidised to sulphate, while the free sulphur unites with a fresh quantity of sulphide to form soluble bisulphides or even polysulphides. The sulphide of calcium always present in the waste undergoes similar changes. When water falls on the heaps, a deep yellow or orange coloured solution is formed, which contains these polysulphides of calcium, with some hyposulphite of soda and lime. On leaving this liquor exposed to the air in thin layers during the summer months, oxidation takes place, and hyposulphites and free sulphur are obtained. Or it may be treated with sulphurous acid with the same object; or, lastly, neutral solutions of chloride of manganese or iron may be added, and thus a mixed precipitate procured of sulphides and sulphur, which may be burned to furnish sulphuric acid. All this, we believe, has already been done by Messrs. Townsend and Walker.

Some discussion followed the reading of this paper, in which M. Pelouze mentioned a process of M. Schaffner, who decomposes the yellow solution obtained after the exposure of the waste with dilute hydrochloric acid or chlorine residues, and thus recovers a portion of the sulphur.

M. Dumas afterwards pointed out the principal features of M. Kopp's processes.

M. H. St. Claire Deville communicated a note from M. Fongué, describing his visits to Stromboli, Vulcano, and Panaria, and giving analyses of gases from fumaroles on those volcanic islands. Around some of the fumaroles he found deposits of sulphide of arsenic, chloride of iron, sal ammonia, sulphur, and boracic acid, and the gases were, in a few instances, principally composed of sulphurous and chlorhydric acids.

The Academy seems deluged with communications on the subject of cholera. Many of these dwell on the almost universal occurrence of premonitory diarrhœa, and the importance of immediate treatment.

To Blacken Zinc Statues, &c.—Make a solution of six parts chloride of antimony in one part of alcohol and four parts hydrochloric acid, and apply it to the object with a brush. Wipe the figure over with a wet cloth, and then apply the solution a second time. Now dry the object as quickly as possible in a warm place. When it is perfectly dry rub it all over with oil.—*Deutch. Illust. Gewerbztg*, 1864.

NOTICES OF BOOKS.

A Practical Treatise on Coal, Petroleum, and other Distilled Oils. By Abraham Gesner, M.D., F.G.S. Second edition. Revised and enlarged, by George Weldten Gesner, Consulting Chemist and Engineer. London: H. Baillière. 1865.

Although it is impossible to give unqualified praise to any part of this book, we are bound to say that it is one which, in the present dearth of practical works on the subject deserves some commendation. It seems strange that so important an industry has not produced more books, but the reason for this, we imagine, is to be found in the fact that the manufacture of coal oils has been so much embarrassed by the operation of our patent laws, that few have hitherto cared to engage in the pursuit. However that may have been, we have noticed that a larger number of inquiries have been addressed to us for information on this subject than on any other, and we may now content ourselves with recommending this book to the perusal of all who wish for practical information on the subject of which it treats.

Our readers will understand from the above that it is the practical part of the book alone which we commend. The chemistry is, indeed, of a kind which had better been omitted, and which if the book should reach a third edition must undergo a thorough revision by a competent chemist.

It is proper to add that the book is illustrated with drawings of ovens, retorts, stills, and other necessary apparatus, which will be found extremely useful as guides to those who think of embarking in the manufacture of coal and shale oils.

Annales de Physique et de Chimie. August, 1865.

In this number we find the completion of the article by Dr. Icery "*On the Juice of the Sugar Cane, and the Changes it undergoes in the Manufacture of Sugar.*" It is a most valuable contribution to our knowledge of the natural history of sugar, and well deserves the attention of all engaged in the manufacture. A fourth memoir by M. A. Dupré, "*On the Mechanical Theory of Heat,*" and devoted to the study of latent heats, is the only other article which has not already received notice in our pages. In this number the valuable review of foreign (that is, other than French) memoirs of M. Wurtz is resumed; but in this we find nothing for notice.

Zeitschrift für Analytische Chemie. Part 1. Vol. IV.

This journal opens with an article by Dr. Gerlach "*On Areometer Scales,*" which is accompanied by a very useful table for the comparison of Twaddle's with Beaume's and other scales, and also with the specific gravity. The author has compiled it for liquids both heavier and lighter than water. The next is an article by E. Fleischer "*On the Volumetric Determination of Alumina and Phosphoric Acid.*" The author estimates the one with a standard solution of potash alum, and the other with a standard solution of phosphate of soda. Our readers will see that these processes can have but a very limited application. W. Casselman, in a paper "*On a Remarkable Formation of a Basic Salt of Cupric Acid,*" describes a salt having the general formula $2(4CuO + Acid)7HO$, which is made by boiling the solution of a copper salt with a salt of formic, acetic, propionic, or valerianic acid. Dr. Piccard describes a rather injurious "*Way of Hastening Filtrations.*" He fits the funnel with a filter into one neck of a two-necked Wolff's bottle. From the other he carries a tube which he connects with a water aspirator. Some atmospheric pressure is thereby maintained on the fluid in the filter, and the filtration consequently accelerated. Some remarks by

Fausto Sestini "*On the Preparation of Pure Lime for Use in the Elementary Analysis of Organic Substances,*" do not call for much notice. The author impregnates the purest statuary marble with a thick syrup, and then burns it When the lime is causticised, he makes thin milk of lime, in which any carbonaceous matter deposits. He then collects the lime on a filter, and washes well to remove any sulphide of calcium which may have been formed from sulphate in the marble. He then dissolves the lime in nitric acid, precipitates with carbonate of ammonia, and again burns the carbonate into quick lime. He thus obtains lime quite free from chlorine and sulphuric acid, and so adapted for use in the analysis of organic bodies containing chlorine.

Among the communications from Fresenius's laboratory we notice a paper by F. Gauhe "*On the Methods of Estimating Cobalt and Nickel;*" another by A. Souchay, "*On the Estimation of Lead as Sulphide;*" and one by the same author "*On the Determination of Chromium as Hydrated Oxide, and Weighing as Oxide.*" In the last paper the author points out a common error in the solution of the glass in which the precipitation and washing is effected, and recommends the use of a porcelain or platinum dish.

The next is an article by Fresenius "*On the Analysis of Raw Iron,*" to which we shall return.

In another short paper Fresenius gives a small hint for the laboratory. Every one knows that the iron-wire gauze on which we heat beakers over a gas flame burns out in the middle, and soon becomes useless. Fresenius suggests taking a thin, square plate of iron for the beaker to rest upon, and fastening it to the gauze by the corners. This, he says, will form a very safe rest for the beaker, and will hold a long time.

The remaining articles call for no notice.

Journal de Pharmacie et de Chemie. September, 1865.

Made up for the most part of communications to the Academy of Sciences, and many of these of distant date, there is nothing in this number which requires notice.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

2296. J. Dawson, Greenock, Renfrewshire, N.B., "Improvements in supplying charcoal to sugar decolourising vessels, and in apparatus therefor."—September 7, 1865.

2327. J. Lightfoot, Accrington, Lancashire, "Improvements in dyeing and printing fabrics and yarns and animal or mixed animal and vegetable substances."—September 11, 1865.

2385. J. Fletcher, Betts Street, St. George's-in-the-East, Middlesex, "Improvements in the machinery or apparatus and in the processes for the treatment and manufacture of sugar."

2390. J. S. McDougall, Manchester, "Improvements in the manufacture of insoluble oils and greases."—September 19, 1865.

2409. W. Clark, Chancery Lane, "Improvements in the manufacture of materials for decolourising sugars and other saccharine and liquid matters." A communication from C. J. Gaade, Boulevart St. Martin, Paris.

2415. A. Bird, Birmingham, "Improvements in purifying water."—September 21, 1865.

2427. P. Spence, Newton Heath, Manchester, "Improvements in the manufacture of white lead."—September 22, 1865.

2435. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in generating illuminating gas, and in the machinery or apparatus employed therein." A communication from E. A. Pond, M. S. Richardson, and E. A. Morse, Rutland, Vermont, U.S.A.

2439. A. V. Newton, Chancery Lane, "Improved apparatus for generating illuminating gas." A communication from J. Irwin, Chicago, Illinois, U.S.A.

2443. M. Schaffner, Aussig, Bohemia, "Improvements in treating soda waste to obtain sulphur therefrom."—Sept. 23, 1865.

2451. E. Brooke, the younger, Huddersfield, "An improved arrangement of apparatus and materials to be employed for effecting the deodorising of the noxious gases arising from sewers and drains, and for the more effectual ventilation and inspection of such sewers and drains."—Sept. 25, 1865.

2469. G. T. Bousfield, Loughborough Park, Brixton, "Improvements in machinery for tempering and preparing peat for fuel." A communication from N. F. Potter, Providence, Rhode Island, U.S.A.—Sept. 26, 1865.

Notices to Proceed.

1352. W. Wright, Mostyn, Flintshire, "Improvements in the treatment of the waste liquors obtained after treating burnt ores of copper, such improvements having for their object the production or extraction of cobalt and nickel."

1461. G. Walton, Weardale Villa, Clapton, "Improvements in apparatus used in distilling hydrocarbons."—May 16, 1865.

1385. T. Richardson, Newcastle-upon-Tyne, and M. D. Rücker, Leadenhall Street, London, "Improvements in obtaining certain compounds of nitrogen and of sulphur."—May 19, 1865.

1435. J. Gyers, Middlesborough, "Improvements in ovens or kilns for the manufacture of coke."—May 25, 1865.

1545. C. H. Wansbrough, Shrewton, Wiltshire, "Improvements in the treatment of condensing pans employed in the condensation of milk."—A communication from S. Percy, New York, U.S.A.—June 5, 1865.

1553. J. Howarth, M.D., Andover, Essex, Mass, U.S.A., "An improved method and apparatus for distilling coal, shale, and other carbonaceous substances."—A communication from J. Howarth, Salem, U.S.A.—June 7, 1865.

2289. T. Nicholson, Gateshead, "An improved process of and apparatus for making caustic liquor or caustic lees."—September 6, 1865.

1420. J. Dale and A. Paraf, Manchester, "Improvements in calico and linen printing."—May 24, 1865.

1448. R. Canham, Clerkenwell, Middlesex, "Improvements in cupola and other blast furnaces."

1450. C. B. Spaeth, Philpot Lane, London, "A new preparation for subduing and extinguishing fire." A communication from G. Zeisler, Leipsig, Saxony.—May 26, 1865.

1453. S. Sequelin, Devonshire Street, Bloomsbury, "Improvements in purifying animal and vegetable oils or fatty matters to be used for lubricating and other purposes."—May 27, 1865.

1489. T. Spencer, Euston Square, Middlesex, "Improvements in the composition and manufacture of paints applicable to iron and other ships' bottoms, and for other general purposes."—May 31, 1865.

2153. G. G. Dennis, Boston, Mass., U.S.A., "Improvements in friction matches, lucifer matches, and matches for re-lighting called taper matches."—August 21, 1865.

MISCELLANEOUS.

Ozone.—At the meeting of the British Association, Dr. B. W. Richardson read a paper on certain physiological experiments with ozone. The following are the reliable facts known up to this time respecting ozone:—

1. Ozone in a natural state is always present in the air in minute proportions—viz., one part in ten thousand.

2. It is destroyed in large towns, and with special rapidity in crowded, close, and filthy localities.

3. Ozone gives to oxygen properties which enable it to support life. In this respect it acts like heat—its effects are destroyed by great heat.

4. Ozone diffused through air in minute quantities produces, on inhalation, distinct symptoms of acute catarrh—common cold.

5. When animals are subjected to ozone in large quantities, the symptoms produced, at a temperature of 75°, are those of inflammation of the throat and mucous membranes generally, and at last congestive bronchitis, which in carnivorous animals is often rapidly fatal.

6. When animals are subjected for a long period to ozone in small proportions, the agent acts differently, according to the animal. The carnivora die, after some hours, from disorganisation of the blood; but the herbivora will live live for weeks, and will suffer from no acute disease.

7. The question whether the presence of ozone in the air can produce actual disease must be answered cautiously. Science has yet no actual demonstrative evidence on the point. But the facts approach to demonstration that common cold—catarrh—is induced by this agent. All else is as yet speculative.

8. During periods of intense heat of weather, the ozone loses its active power.

9. On dead organic matter undergoing putrefaction ozone acts rapidly—it entirely deodorises by breaking up the ammoniacal products of decomposition, at the same time it hastens the organic destruction.

10. There is an opposite condition of air in which the oxygen is rendered negative in its action, as compared with the air when it is charged with ozone. Air can thus be rendered negative by merely subjecting it over and over again to animals for respiration. The purification of such air from carbonic acid and other tangible impurities does not render it capable of supporting healthy life; but ozone restores the power. In a negative condition of air, the purification of the organic matter is greatly modified, and the offensive products are increased. Wounds become unhealthy, and heal slowly in such negative air.

11. There is no demonstrative evidence as yet that any diseases are actually caused by this negative condition of air; but the inference is fair that diseases which show a putrefactive tendency are influenced injuriously by a negative condition of the oxygen of the air. It is also probable that during this state decomposing organic poisoning matters become more injurious.

12. As ozone is used up in crowded localities, and as it is essential that ozone should be constantly supplied in order to sustain the removal of decomposing substances and their products, no mere attention to ventilation and other mechanical measures of a sanitary kind can be fully effective unless the air introduced be made active by ozone. Fever hospitals and other large buildings in towns should be artificially fed with ozonised air.

Schultze's White Gunpowder.—This is tri-nitrocellulose, prepared from saw-dust by the following process. The saw-dust is first boiled for three or four hours with a weak soda solution, and then boiled a second time with a fresh lot of the same solution. It is then washed in running water, afterwards steamed for fifteen minutes, and then again washed in running water for twenty-four hours. It is now bleached with chlorine or chloride of lime, boiled in water, once more washed in a stream, and now dried. The saw-dust is now ready to be treated with nitric acid. For this purpose a mixture of 40 parts strong nitric acid (1·48 to 1·50) are mixed with 100 parts of sulphuric acid (1·84); and the mixture is allowed to stand two hours to cool. One hundred parts of this mixture are then placed in an iron vessel, around which a stream of cold water circulates, and six parts of the saw-dust are gradually added, stirring all the time. The saw-dust is allowed to remain in the acid two or three hours, the stirring being continued. After this time the whole is transferred to a centrifugal machine, and the acid separated. The wood is then washed for two or three days in cold water, afterwards boiled in a weak soda solution, again well washed in cold water, and then dried. It is now ready for the final operation, which consists in soaking it for ten or fifteen minutes in a solution of 26 parts of nitrate of potash in 220 parts of water. After this, it is carefully dried at a temperature not exceeding 44° C.; the very fine dust is then separated by means of a drum sieve, and the remainder is ready for market.—*Chem. Central Blatt*, No. 44, p. 704.

Chromometrical Analysis.—Messrs. Siemens and Halske have devised an apparatus for determining the quantity of copper contained in a solution by comparing its colour with that of a standard solution. The apparatus consists essentially of two vertical tubes fixed side by side, in one of which is placed a piece of blue glass. The other tube dips into a larger tube, in the bottom of which is a piece of white glass. Light is reflected from a mirror through both these tubes. The substance to be analysed having been dissolved in acid, a certain quantity of ammonia is added, until the well-known blue colour is obtained. The solution is then to be placed in the larger tube. By means of a suitable mechanism, the frame carrying the two tubes is moved up or down, thus varying the thickness of the layer of the solution to be tested through which the light passes, until the depth of tint of the blue glass and of the solution appear to be the same. The length of the column may be read off on a scale, and the blue glass having been previously compared with a standard solution, the amount of copper in the fluid under examination may be easily estimated. Comparative determinations by ordinary analysis gave very slight variations in the results.—*Reader*.

Test for Otto of Roses.—Hager mixes five drops of the otto to be tested with twenty drops of pure concentrated sulphuric acid. Whether the oil be adulterated or not, a thick yellowish brown or reddish brown mixture results. When this mixture is cold, it is shaken up with three drachms of absolute alcohol. If now the otto is pure, a tolerably clear yellowish brown solution results, which, after heating to boiling, remains clear. But if the otto is adulterated with geranium, palm rose, or pelargonium oil, the solution remains very cloudy, and in some cases a darker fluid separates, in which a deposit forms. On heating this solution, the sediment melts together, and from the size of the mass the author infers the degree of adulteration. If, for example, the mass has one-fourth the volume of a drop, he concludes that the otto was mixed with at least one-third of foreign oil. If the otto is adulterated with spermaceti, this substance separates and floats on the surface of the solution, or remains suspended in the liquid as a scaly crystalline mass. The above test is founded on the circumstance that pure otto of rose forms, with strong sulphuric acid, a resinous substance, which is completely soluble in absolute alcohol; while the substance formed with other oils is only partially soluble. Guibourt has observed that the odour of pure otto is not affected by mixture with strong sulphuric acid, but if other oils are present a disagreeable odour is developed.—*Zeitscht. für Analyt. Chem.*, No. 4, 1864, p. 479.

ANSWERS TO CORRESPONDENTS.

Alpha.—Cochineal and oxalic acid. The quantities to be determined by strength of colour required.

E. M. N.—We do not dispute that caustic soda exposed to air becomes carbonate; but our correspondent asserted that the caustic soda parted with oxygen. This is incorrect.

C. S.—Ignition of solid residue with proper precautions is the most satisfactory, but not perfect method.

Received.—99; C. Greville Williams, F.R.S.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Presence of Didymium in Churchite, by C. Greville Williams, *F.R.S.*

In the course of some recent experiments upon the preparation of pure cerium, I found Gladstone's optical test always to reveal the presence of didymium in oxide of cerium, no matter how carefully prepared by any of the methods at present in use. It is also well known that the oxide of cerium, from all the minerals which have as yet been discovered, contains didymium and lanthanum. This made me desirous of ascertaining whether the new and highly interesting mineral described by Professor Church in the Chemical News for September 15, 1865 (and for which I venture to propose the name of churchite), contained cerium only, as, if so, it would be the only one known from which pure cerium compounds could be prepared. It is true that Church assumes in his notice that the oxide of cerium obtained by him consisted of the mixed earths; but as he does not state that he specially searched for the other metals, I presume he took it for granted that didymium and lanthanum were present in the oxide weighed by him. I, therefore, seized the first opportunity of optically examining a solution of the mixed cerium earths from churchite, the result being that the lines indicative of didymium showed themselves in the most distinct and beautiful manner.

The above experiment with the prism serves, therefore, to confirm the results of Professor Church's chemical analysis, and indicates the cerium earths in churchite to consist of the same mixture found in cerite, allanite, orthite, &c.

Churchite is so little known at present, and appears to be so excessively rare, that some time will probably elapse before enough will be obtained to enable the presence of lanthanum to be determined chemically.

Revision of the Mineral Phosphates, by A. H. Church, *M.A. Oxon., Professor of Chemistry, Royal Agricultural College, Cirencester.*

No. V.—Uranite.

(Continued from vol. x., page 291.)

There is no occasion to question the generally-received formula for uranite (the torberite of Brooke and Miller). Assuming the atomic weights of copper = 63·5, and that of uranium = 120, the expression for uranite is—

$$2\overset{\prime\prime\prime}{U}_2O_3,\overset{\prime\prime}{C}uO,P_2O_5 + 8aq.$$

This, with the lower atomic weight, becomes in the mineralogical notation—

$$2\ddot{U}_2,\dot{C}u,\overset{\cdot\cdot\cdot\cdot\cdot}{P} + 8\dot{H}.$$

But there is one point connected with the chemistry, of this mineral which seems to demand inquiry. The existence of a lime-uranite has been well established; it is now usually distinguished as a good species, and termed autunite. In autunite, which is generally of a pure lemon or sulphur yellow colour, the oxide of copper of the green uranite has been entirely replaced by lime. But there exist numerous specimens of uranite which are exactly intermediate in colour between uranite and autunite; these have sometimes been classed with one species, sometimes with the other. From my experiments I believe one may be justified, where other characters are indeterminate, in classing all apple-green and siskin-green uranites with the true copper uranite; I have not as yet met with any green autunite. The following analyses were made with a very pale Cornish specimen; the lime, it will be seen, is in very insignificant proportion; the presence of nearly 2 per cent. of As_2O_5 replacing part of the P_2O_5 is, however, worthy of note —

	a	*b*	
U_2O_3	.	61·00	per cent.
CuO	8·71	8·56	,,
CaO	.	·62	,,
P_2O_5	13·99	13·94	,,
As_2O_5	.	1·96	,,
H_2O	.	14·16	,,
		100·24	

The following are the percentages demanded by the formula before given:—

U_2O_3	61·18
CuO	8·44
P_2O_5	15·10
H_2O	15·28

These numbers closely accord with the experimental values previously recorded. The specimen analysed, though it might easily have been mistaken for autunite, contained the full percentage of CuO found in uranite. The arsenic acid has not, I believe, been previously observed in this mineral. The deficiency of water arose from the over-drying of the powdered substance. In vacuo over oil of vitriol it loses part of its water of crystallisation, and becomes yellow where a thin layer of the powdered mineral is exposed. In the ordinary air of a room it reassumes its natural tint, and regains part of the water lost.

PHARMACY, TOXICOLOGY, &c.

Report on the Quantity of Alkaloid in various Specimens of Citrate of Iron and Quinine, by Mr. J. C. Braithwaite.*

In a former paper, I gave the results of my investigation as to the quantity of alkaloid contained in various specimens of this valuable medicine, and expressed my opinion that quinidine, if not cinchonine, would be found in more than one sample. This opinion has been confirmed by further investigation.

In sample No. 1, containing 1·504 per cent. of quinine (equal to 2·35 per cent. of the citrate), I found neither quinidine nor cinchonine, but the quantity experimented upon was very small.

No. 2, with 1·52 per cent. of quinine (equal to 2·375 per cent. of the citrate, contained neither quinidine nor cinchonine.

These two alkaloids were also absent in No. 3, containing 3·732 per cent. of quinine (equal to 5·831 per cent. of the citrate); in No. 4, containing 4· 2 per cent. of quinine (equal to 6·437 per cent. of citrate); in No. 5, containing 4·76 per cent. of quinine (equal to 7·437 per cent. of citrate); and in No. 6, containing 6 per cent. of quinine (equal to 9·375 per cent. of citrate).

No. 7 contained 7·372 per cent. of alkaloid, which, if pure quinine, would represent 11·518 per cent. of the citrate. This sample, however, contained only a mere trace of quinine, the great proportion of alkaloid being quinidine, which crystallised out from the ethereal solution. I have reason to believe that cinchonine also occurs

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* Read at the meeting of the Pharmaceutical Conference.

in this sample, but my investigation is not yet satisfactorily completed.

No. 8 contained 9·292 per cent. of alkaloid, which, were it quinine, would represent 14·518 per cent. of the citrate; but, in this case also, it consisted of quinidine, with only a mere trace of quinine. No cinchonine could be detected.

No. 9, containing 11·24 per cent. of quinine (equal to 17·56 per cent. of the citrate), was free from quinidine and cinchonine. The same remark applies to No. 10, containing 12·26 per cent. of quinine (equal to 19·162 per cent. of citrate), and to No. 11, containing 12·94 per cent. of quinine (representing 20·22 per cent. of the citrate).

In No. 12, containing 14·72 per cent. of quinine (equal to 23 per cent. of citrate), a small quantity of quinidine was found, but no cinchonine.

Traces of quinidine, but none of cinchonine, were also detected in No. 13, containing 14·784 per cent. of quinine (equal to 23·09 per cent. of citrate); in No. 14, containing 14·88 per cent. of quinine (representing 23·25 per cent. of citrate); and in No. 15, containing 15·84 per cent. of quinine (representing 24·75 per cent. of the citrate).

It had been my intention to have completed the subject in this paper by estimating the quantity of iron contained in each sample, but I have been prevented doing so by indisposition, and must therefore postpone it to a future period. I subjoin the result of my examination of nine more examples, seven of which (Nos. 16, 18, 19, 20, 21, 22, and 23) were kindly forwarded to me by Dr. Attfield.

No. 16.—This specimen had become damp, and had run into a mass of a dark olive-green colour. It dissolved readily in water, yielding a solution of a greenish-yellow colour, and somewhat turbid. It had an acid reaction upon test-paper, and possessed only a very slight bitter taste. The precipitate, by ammonia, when dry, was of a brownish colour, with a slight whitish bloom upon it, closely adherent to the paper, and in small quantity only.

As this specimen was difficult to remove from the bottle in which it was contained, and I had a very small quantity of it only, I operated upon the whole, which weighed 62 grains, and obtained 1 grain of quinine, or 1·603 per cent., equal to 2·504 per cent. of the citrate of quinine. This had merely a private mark upon the label, and was one of the samples forwarded to me by Dr. Attfield. It dissolved entirely in ether, yielding a pale yellow solution.

No. 17 occurred in the form of golden-coloured scales, much resembling those of No. 24, but not so bright, being covered with a slight bloom. Exposed to the air at a temperature of 60°, they absorbed moisture, and ran into a gum-like mass firmly adherent to the paper on which they were placed. This specimen dissolved readily in water, yielding a clear yellow solution which had an acid reaction upon test-paper, and was less bitter to the taste than either of the other specimens except No. 16. The precipitate by ammonia, when dry, shrank to a mere nothing; it had a yellowish-brown colour, and was completely adherent to the paper. From two analyses of twenty-five grains each, I obtained 0·68, 0·68, equal to 2·72 per cent. of quinine, or 4·25 per cent. of citrate of quinine. When treated with ether it was entirely dissolved, yielding a solution of a very pale colour. This preparation is stated upon the label "to contain 25 per cent. of citrate of quinine," and it was also "verbally guaranteed to do so" when purchased. The name of the maker, however, is omitted upon the label.

No. 18 occurred in fine golden scales, much resembling those of No. 24. Exposed to a temperature of 60°, it absorbed moisture and became adherent to the paper upon which it was placed. It dissolved readily in water, yielding a yellowish solution which had an acid reaction upon test-paper, and possessed but slight bitterness, as most of the others.

The precipitate yielded by ammonia was not very copious. It had, when dry, a light brownish colour, with a faint white bloom over the surface, and firmly adhered to the filter.

From two analyses of twenty-five grains each, I obtained 0·69, 0·73; mean 0·71, equal to 2·84 per cent. of quinine, and 4·437 per cent. of citrate of quinine. This was entirely soluble in ether, yielding a solution of a very pale colour.

No. 19. This specimen consisted of very small scales of a dull olive-yellow colour. Exposed to the air at a temperature of 60°, it remained unchanged for a considerable time, but ultimately absorbed moisture and became adherent to the paper upon which it was placed. It dissolved readily in water, yielding a clear yellow solution, which had an acid reaction upon test-paper, but possessed but little bitterness. Only a small quantity of precipitate was thrown down by ammonia, which, when dry, very much resembled that immediately preceding it, being of a light brown colour, with a white bloom over it, and closely adherent to the filter.

From two analyses of twenty-five grains each, I obtained 1·06, 1·03; mean 1·045, equal to 4·18 per cent. of quinine, and 6·531 per cent. of its citrate.

It dissolved entirely in ammonia, yielding a pale yellow solution.

No. 20 occurred in small granules, and it appeared as if it had been damp and had run together, and been afterwards dried. It had a very dark olive colour, approaching a blackish hue. Exposed to a temperature of 60°, it remained unaffected. It dissolved readily in water, yielding a yellowish solution, which was slightly turbid. It had an acid reaction upon test-paper, and a bitter taste, but of much less intensity than that of Nos. 22 and 23. The precipitate by ammonia, when dry, was not very bulky; it had a very dark colour, and separated very readily from the filter.

From two analyses of twenty-five grains each, I obtained 1·12, 1·09; mean 1·105, equal to 4·42 per cent. of quinine, and 6·906 per cent. of its citrate.

It was almost entirely soluble in ether, yielding a solution of a yellowish colour, but less deep than the two preceding ones.

No. 21. This sample was composed of small granules of a dark olive brown colour, intermixed with a few small scales of a somewhat lighter colour. Had apparently got damp and been dried. Exposed to the air at a temperature of 60°, it remained unchanged. It dissolved readily in water, yielding a solution of somewhat deeper colour than either of the preceding, slightly turbid, having an acid reaction upon test-paper, and an intensely bitter taste, but not chalybeate. With ammonia it yielded a copious precipitate, which, when dry, had a dark brown colour with a white bloom, and a very resinous appearance.

From two analyses of twenty-five grains each I obtained 3·25, 3·22; mean 3·235, equal to 12·94 per cent. of quinine, and 20·218 per cent. of its citrate.

This was almost entirely soluble in ether, and the solution closely resembled those of Nos. 22 and 23 in colour.

No. 22. This consisted of bright golden-coloured scales, rather darker in colour than No. 24. Exposed to the air at a temperature of 60°, it was unaffected. It dissolved very readily in water, yielding a somewhat turbid yellowish solution with an acid reaction upon test-paper, and a strongly bitter taste, but was not very chalybeate. The precipitate thrown down by ammonia was copious, and when dried had a brownish resinous appearance, its surface being covered with a white bloom, and was readily separable from the filter.

From two analyses of twenty-five grains each, I obtained 3·46, 3·54; mean 3·5, equal to 14 per cent. of quinine, and 21·87 per cent. of its citrate.

It was almost entirely soluble in ether, yielding a yellowish solution.

No. 23 was composed of golden-olive scales, having a greenish shade. Exposed to the air at the temperature of 60°, it was unaffected. It dissolved readily in water, yielding a yellowish solution much the same as the preceding, but not quite so clear, and having an acid reaction upon test-paper, and a strongly bitter but not chalybeate taste. The precipitate by ammonia much resembled that of No. 22 in appearance, having a resinous aspect and a brownish colour, covered with a white bloom, and separated pretty readily from the paper.

From two analyses of twenty-five grains each, I obtained 3·76, 3·76, equal to 15·04 per cent. of quinine, or 23·5 of its citrate.

It was almost entirely soluble in ammonia, and closely resembled the preceding in the colour of its ethereal solution.

No. 24 occurred in the form of very bright fine golden green scales. Exposed to the air at a temperature of 60°, it remained unaltered. It dissolved very readily in water, yielding a fine golden-yellow solution, which was beautifully clear, and had an acid reaction upon test-paper. It was intensely bitter, but not chalybeate. Ammonia produced a very copious precipitate, which, when dry, was of a light brown colour, and of a very resinous appearance.

From two analyses of twenty-five grains each, I obtained 4·2, 4·18; mean 4·19, equal to 16·72 per cent. of quinine, or 26·75 per cent. of its citrate.

This is entirely soluble in ammonia, yielding an almost clear solution. I may mention that this specimen was prepared by my own formula, a little additional quinine having been purposely added, to ascertain if it were possible to combine a greater amount of citrate of quinine than 25 per cent., and at the same time retain brilliancy of colour and appearance, and ready solubility of the medicine.

54, Kentish Town Road.

THE EXCISE LABORATORY.

REPORT FROM THE PRINCIPAL TO THE COMMISSIONERS OF THE INLAND REVENUE, 1865.

(Continued from page 174.)

Snuff.—The adulteration of snuff with large quantities of lime still continues to be practised in Ireland, the existing law being insufficient for its suppression. In my last Report I dwelt at some length upon this subject, and endeavoured to point out the pernicious effects of the fraud, and that the use of lime in the manufacture of snuff was not only unnecessary, but that it actually depreciated the value of the commodity. It may be reasonably supposed that those manufacturers who have adopted the reprehensible practice will, finding that the revenue is at present powerless to repress their unscrupulous operations, avail themselves of the opportunity to increase, as far as possible, the proportion of lime which they add to their snuff: that they are doing this is, I think, proved by the fact that several samples of high-dried snuff from Ireland have been recently analysed and found to contain lime in proportions varying from 20 to 25 per cent., quantities considerably in excess of those found in previous years. The adulteration of snuff by other materials than lime is now, I believe, but seldom attempted, and this absence of fraud in the trade is no doubt partly due to the conviction which the fraudulent manufacturers have, from costly experience, at length arrived at, that owing to improved modes of analysis, the efficient use of the microscope, and the vigilant supervision of the revenue officers, it has become very unsafe to sophisticate their commodities; and partly to the sufficiency of the law to deal with such cases of fraud, and to the large penalties imposed when the fact of adulteration has been proved.

Only one detection of importance of the adulteration of snuff with materials other than lime has been made during the past year, about half a ton of snuff containing a large proportion of ground fustic having been seized on the premises of a manufacturer in London. Two samples were also found to contain about 58 per cent. of sand.

Samples of Snuff Analysed.

Year.	Number of Samples.		
	Genuine.	Adulterated.	Total.
1862 .	8	4	12
1863 .	32	25	57
1864 .	4	16	20

Pepper.—Perhaps no article subject to revenue duties is more sophisticated than pepper, a fact to which, in my former Reports, I have frequently adverted. That a substance which is only used in small quantities as a condiment should be so liable to adulteration may seem remarkable if the circumstance be overlooked that it may be mixed with its own weight of illicit and almost worthless ingredients without its being rendered unsaleable on the score of the want of pungency. It is not surprising, therefore, that needy and dishonest retailers should attempt to secure a little extra profit on an article which can be so easily tampered with, or that unscrupulous persons who may be extensively engaged in the grinding and sale of the commodity should seek to obtain large gains by resorting to the fraudulent practice.

Under this head thirteen samples have been analysed, seven of which were found to be illicit. Four samples were imitation pepper so skilfully prepared as to be indistinguishable by the naked eye from genuine black pepper, with which they were, no doubt, intended to have been mixed. These samples contained about 22 per cent. of gypsum (sulphate of lime), the remainder being starch, sand, and the husks of red mustard seed. One sample was composed of a mixture of pepper with 45 per cent. of imitation pepper, whilst two samples of white pepper were largely adulterated with ground rice, one of them to the extent of 20 per cent.

Samples of Pepper Analysed.

Years.	Number of samples.		
	Genuine.	Adulterated.	Total.
1862 . .	6	2	8
1863 . .	12	18	30
1864 . .	6	7	13

Coffee.—The selling of mixtures of coffee and chicory having been for many years permitted, it was not unreasonable to expect that when the duties on the two commodities were equalised, the unscrupulous dealers in coffee would seek to retain their illicit profits by resorting to other substances than chicory, in order to impose on the public and defraud the revenue. It was at first thought that chicory itself would become an object of sophistication, and that the consumers of coffee would be victims to an adulteration within an adulteration. This, however, does not, as yet, appear to be the case, and there are good reasons for believing that coffee is now being extensively sold mixed with large proportions of burnt sugar or caramel, a substance of comparatively little value, but much better adapted for the purpose than even chicory itself, and one which enables the dealers to command a higher price for coffee containing it than they could obtain for the coffee alone, some of them selling the mixture at 1s. 10d., and even 2s. per lb. Several prosecutions of dealers who have sold coffee mixed with burnt sugar are now depending, and the evil will, I fear, rapidly spread, unless prompt and energetic measures be persisted in for its suppression.

One sample of coffee purchased in London was found to be largely adulterated with mustard husks, a form of adulteration which has but very rarely occurred.

Sixty-one samples of coffee were examined in my department during the year.

Beer.—The repeal of the duty on hops having rendered the use of other bitter substances permissible in the brewing of beer, it is now only necessary to take cognisance of those ingredients which may be used as substitutes for malt.

Beer being a staple article of consumption in this country, and one which can be easily tampered with, either by dilution with water and the addition of saccharine matter, for the purpose of increasing bulk, by the use of substances intended to impart an appearance of spirituous strength which the beer does not really possess, or by the use of noxious and poisonous drugs meant to make the beer more intoxicating and stupefying, it is not surprising that it should continue to be an object for ministering to the cupidity of many of those whose business it is to supply it to the public. I have often adverted to the great difficulty that exists in obtaining from the chemical analysis of adulterated beer proof of fraud sufficiently conclusive to secure a conviction in a court of justice, a fact of which the fraudulent dealers in the commodity are, no doubt, aware, and are thereby encouraged to continue their illicit practices with impunity. Thus the most usual mode of adulterating beer, and one which there are good grounds for believing is very generally practised by the publicans in London, is to add water to the beverage, the injury to the fullness or "body" of the article arising from this dilution being repaired by the introduction of sugar, treacle, or other saccharine matter—a description of fraud the commission of which cannot, in the present state of chemical knowledge, be satisfactorily proved by analysis.

Within the past year thirty-one samples of beer and materials used by brewers were examined, and of these twenty-three were found to be illicit. In thirteen instances grains of paradise had been used, and in one that drug in conjunction with coriander seeds; in four, coriander seeds alone; and in one, those seeds with a large proportion of white mustard seeds; two samples contained sweet flag (Calamus aromaticus); and another sulphate of iron. It will be observed that no detection of the illicit use of cocculus indicus, tobacco, or other poisonous substances has been made.

Malt.—Of this commodity, 394 samples were examined in the laboratory, irrespective of those examined for cattle feeding purposes. The system of analysing malt, with a view to prevent frauds on the revenue, has now been nine years in existence, and in that period nearly 3000 samples have been dealt with. The facilities afforded to maltsters for obtaining a remission of duty on grain which vegetates so imperfectly as to render it unfit for the brewing of beer, have rendered it necessary that samples of all such defective malt should be examined, in order that it may be ascertained whether or not the allegations are true upon which the claims for remission are founded. Again, large quantities of malt are annually exported on drawback of duty, samples of which are invariably subjected to examination, the object being to make sure that such malt is fairly merchantable, and entitled to drawback.

The operations of malt roasters continue to be closely watched, and in all cases where there are reasons to suspect fraud, samples are submitted to careful scrutiny in the laboratory.

Wood Naphtha.—Efforts continue to be made by some ingenious persons to secure to themselves an improper advantage through the permission to use duty free spirits in arts and manufactures, and it is much to be regretted that this permission, which was prudentially granted, and which has conferred an almost incalculable benefit on the industrial pursuits of the country, should still be an incitant to attempts to injure not only the interests of the revenue, but also those of the community.

Methods have from time to time been devised for the purpose of rendering methylated spirit potable, but none of these have, I believe, as yet been of a nature to cause any appreciably adverse effect on the revenue, whilst those who adopted them would incur heavy penalties, and be much more liable to detection than the ordinary illicit distiller.

Connected with this subject, however, a source of danger to the revenue has arisen, which was not contemplated when the permission to use duty-free spirit was first allowed—a person having recently adopted a process, the principles of which were published twenty years ago, by which he is enabled to purify wood naphtha to a degree which assimilates it, in physical characters, somewhat closely to vinous alcohol; and although his product cannot, when alone, be deemed quite potable, it is such that might be mixed in large proportions with ordinary spirits, and thus passed into consumption as a beverage without being detected. It may be observed that this purified wood naphtha would be more likely to displace duty-paid spirits than methylated spirits, the cost of the latter being not one-third of that of the naphtha, the preparation of which is expensive, but it yet affords a large margin of profit as against the value of duty-paid spirits, there being no duty chargeable upon it, and no law to prevent its purification.

Within the past year several attempts have been made to import from the Continent wood spirit containing large quantities of vinous alcohol, and there can be no doubt that the intending importers contemplated a fraud on the spirit revenue of this country. Samples of these mixtures were examined in the laboratory at the request of the Customs, and I think it would be advisable to have all the wood spirit imported similarly tested.

A few instances have been discovered of the sale of drinks under the names of "Indianna brandy," "[illegible] cated whiskee," "pure Islay mountain," "Indian tincture," and "red currant cough elixir," the exciting principle of all of which was found to be hyponitrous ether prepared from methylated spirit. The above compounds were all highly stimulating, and it would appear that they are consumed by some of the poor, because they produce intoxication at the cost of only a few pence, whilst there are good reasons for believing that hyponitrous ether itself, and in some parts of Ireland even sulphuric ether, are used by the needy classes for the same object. It is difficult to see how this evil, so pernicious to the moral and physical welfare of those who indulge in it, can be checked, as the substances under consideration possess more the character of medicines than of ordinary spirits, and may thus be legally kept and sold by any chemist.

During the year 139 samples of wood spirit were examined, the object being to ascertain that they were free from vinous alcohol, and suitable for methylating spirits of wine.

Miscellaneous Samples. — Under this head 217 samples have been analysed, including spirits, wines, cherry and raspberry brandies, medicated compounds, cane and starch sugars, molasses, treacle, methylated spirits, "Finish," vinegar, chocolate, cocoa, caramel, and cyder.

Total Number of Samples Analysed in the Laboratory in each of the Years 1862, 1863, and 1864.

Description of Samples.	Number of Samples examined in 1862.	1863.	1864.
Tobacco	158	100	158
Snuff	34	57	20
Tobacco exported on drawback	—	1765	1746
Snuff exported on drawback	—	354	260
Pepper	8	30	13
Beer, and substances used in its adulteration	4	26	31
Tea	2	3	—
Coffee	5088	25	61
Malt	327	388	394
Beer (original gravities)	5465	5380	6571
Distillers' wash	16	5	32
Wood spirit	83	95	139
Malt for cattle feeding	—	—	884
Wines (Customs)	—	—	182
Miscellaneous samples	175	360	217
	11,360	8588	10,708

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Weekly Evening Meeting, Friday, April 7.

H.R.H. The Prince of Wales, *Vice-Patron, in the Chair.*

On the Combining Power of Atoms.

By Dr. A. W. Hofmann, *F.R.S.*

(*Continued from page 179.*)

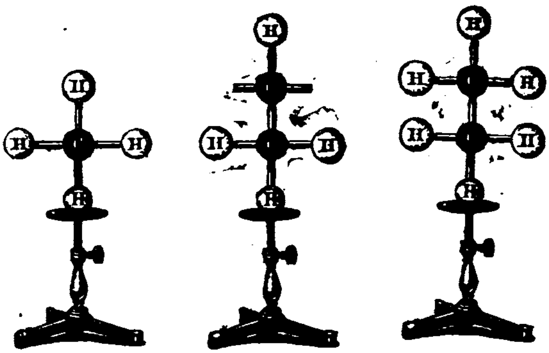
The experience acquired in the study of the oxygen and nitrogen compounds has prepared us for the examination of the increment of carbon. In fact, it is only necessary to apply the method hitherto followed to one of the series of carbon compounds already reviewed to enable us to understand why the carbon atom is assimilated, not atom by atom, like the oxygen atom, not associated with one atom of hydrogen like the nitrogen atom, but associated with two atoms of hydrogen.

We have only to remember that the carbon atom saturates four combining units, while the nitrogen atom saturates only three. Now, we have seen that the rupture of a molecule involves the liberation of two attraction units. The saturation of these two units by the trivalent nitrogen atom left $3-2=1$ attraction unit disengaged; in a similar manner, if the saturation be effected by the quadrivalent carbon atom, $4-2=2$ attraction units must remain unsaturated.

The reason why the carbon atom, when fixed by compounds, associates with two atoms of hydrogen,—why so large a number of carbon compounds differ by CH_2, or a multiple thereof,—in fact, the relation in the composition of numerous series of carbon compounds which is designated by the term *homology* is now intelligible.

In attempting to illustrate this behaviour of the carbon atom by our mechanical models, we conveniently select the molecule of marsh gas, the simplest compound of carbon and hydrogen, as the foundation of our edifice. This molecule we open for the insertion of a second carbon atom. The two attraction units liberated by the rupture of the molecule are saturated by two of the attraction units of the quadrivalent carbon atom, two attraction units of which remain unsaturated. Indeed, two carbon arms remain uncovered, on which we forthwith fasten two atoms of hydrogen. The transformation of marsh gas into hydride of ethyl is thus accomplished.

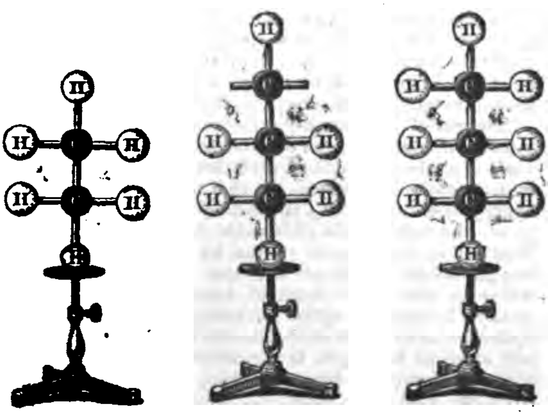
Fig. 15.



Marsh-gas. Hydride of Ethyl.

We open again for the reception of another atom of carbon, and this third atom joins under exactly the same circumstances, carrying along with it into the new molecule the spaces, so to speak, for two additional atoms of hydrogen. Hydride of ethyl in this manner becomes *hydride of propyl.*

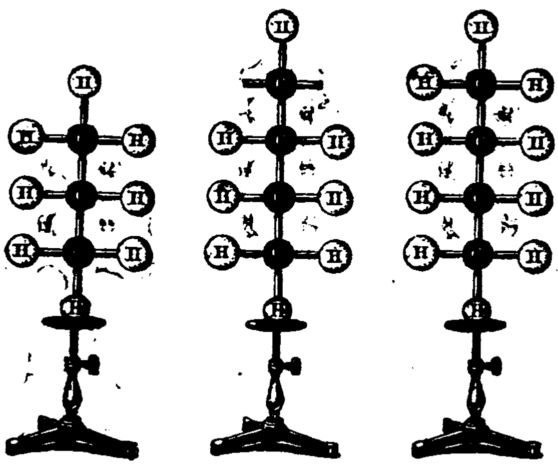
Fig. 16.



Hydride of Ethyl. Hydride of Propyl.

Hydride of propyl, by the accession of a fourth carbon atom, is converted into *hydride of butyl.*

FIG. 17.



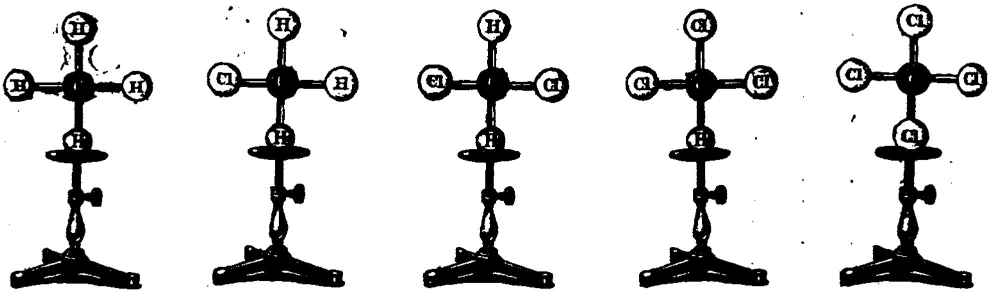
HYDRIDE OF PROPYL. HYDRIDE OF BUTYL.

It is scarcely necessary to expand these illustrations, and if I venture to raise up a few more of these mechanico-chemical edifices, it is because I want to show you that our building stones are available for many other purposes.

Hitherto we have been satisfied with examining under what conditions the atoms of oxygen, of nitrogen, and carbon are received into molecular structures. The question now presents itself, On what terms the chlorine atom is allowed to join?

The model of the marsh-gas molecule is still before us. Let us open this molecule for the reception of a chlorine atom. Two attraction units are thus liberated; but the chlorine atom is univalent. Accordingly two atoms of chlorine are required, one of which combines with the hydrogen atom which we remove from the marsh-gas, converting it into hydrochloric acid which separates, while the other chlorine atom joins the rest of the molecule of marsh-gas. The new molecule, monochlorinetted marsh-gas, may be looked upon as marsh-gas, in which one atom of chlorine holds the position originally occupied by the hydrogen atom. We are thus led up to the recognition of new conditions of combination—conditions which have not as yet attracted our attention this evening, but which unfold to us one of the most important principles of modern chemistry, the principle of *substitution.* The monochlorinetted marsh-gas, which is a liquifiable gas, when again submitted to the action of chlorine loses a second, a third, and lastly, a fourth atom of hydrogen in the form of hydrochloric acid, giving rise to the formation of *dichlorinetted, trichlorinetted marsh-gas*, better known as *chloroform*, and, lastly, of *tetrachlorinetted marsh-gas* or *tetrachloride of carbon*, *i.e.*, marsh-gas in which the four atoms of hydrogen are displaced by an equal number of chlorine atoms (Fig. 18).

FIG. 18.



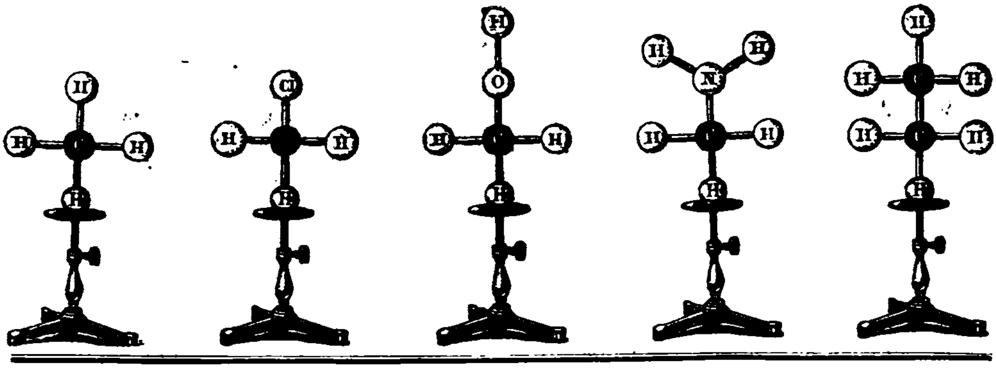
MARSH-GAS. MONOCHLORINETTED MARSH-GAS. DICHLORINETTED MARSH-GAS. TRICHLORINETTED MARSH-GAS. TETRACHLORINETTED MARSH-GAS.

Our information regarding the combining powers of atoms is thus materially expanded. Having already learnt that when entering into a molecular structure the carbon atom associates with two atoms of hydrogen, the atom of nitrogen with *one* atom of hydrogen, that the oxygen atom combines *directly*, we now find that the chlorine atom combines only by *substitution*, *i.e.*, when a space has become vacant in the molecule by the expulsion of hydrogen.

The rest of the marsh-gas molecule remaining after the introduction of one atom of chlorine, and consisting of one atom of carbon, combined with three atoms of hydrogen, is frequently designated by the name of *methyl.* The aggregate of atoms CH_3, the radical methyl, may be traced in all the compounds obtainable from marsh-gas by the insertion of other atoms. Thus, by the assimilation of an oxygen atom, marsh-gas becomes methylic alcohol, *i.e.*, water in which one atom of hydrogen is displaced by methyl, by the absorption of nitrogen with its tributary hydrogen, it becomes methylamine, *i.e.*, ammonia in which one atom of hydrogen is displaced by methyl; by the incorporation of an atom of carbon, lastly, with its pair of hydrogen atoms, the marsh-gas molecule is converted into methyl-marsh-gas, *i.e.*, marsh-gas in which an atom of hydrogen is displaced by methyl.

At one time the exertions of chemists were anxiously directed to the isolation of the atomic aggregate CH_3, of the radical methyl (Fig. 19), from one or other of the methylic bodies just enumerated. The facility with which the chlorine atom in chloride of methyl may be exchanged for other atoms, leaving the aggregate of carbon and hydrogen, which we call methyl, perfectly intact, the mobility of one of the hydrogen atoms in methylic alcohol, and of two of the hydrogen atoms in methylic ammonia, the possibility of replacing even the oxygen and the nitrogen in these compounds, without affecting the methyl, the stability, lastly, of methylic marsh-gas, containing as it does the whole of its carbon and the whole of its hydrogen in the form of methyl, all these circumstances appeared to indicate the probability of the separate existence of methyl. Why all attempts to separate the atom group CH_3 have remained unsuccessful; why methyl could not be caught; why, ultimately when Dr. Frankland's masterly experiments appeared to have precluded all chance of escape, despairing methyl combined with itself, surrendering as methylic marsh-gas or methyl-methyl; why, in fact, it would appear to be an essential character of methyl not to have a separate existence: all these questions are readily answered by our croquet balls,

Fig. 19.



Hydride of Methyl. Chloride of Methyl. Hydrate of Methyl. Amide of Methyl. Methide of Methyl.

which exhibit us methyl as an unfinished molecule, capable of conversion into the finished molecules, hydride, chloride, hydrate, amide and methide of methyl, but not capable of existing as a molecular fragment with imperfectly balanced attractions.

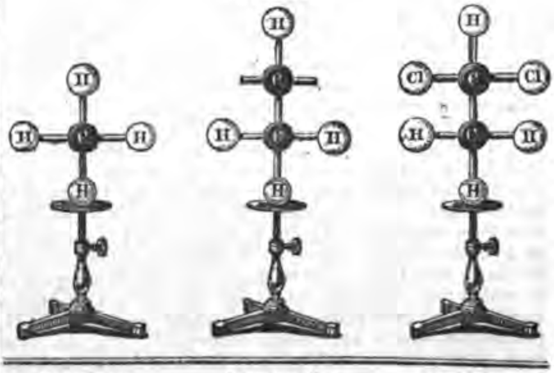
Taking a farewell glance at the results we have elicited this evening, we may fairly ask whether the experience collected on a comparatively limited area is fully and unequivocally corroborated by the examination of a more expanded range of observations? To this question we cannot unhesitatingly give an affirmative answer. It would not be difficult to quote a number of substances, the construction of which appears to have been governed by rules of combination different from those which we have endeavoured to lay down. Indeed, we need not even go beyond the circumscribed field on which we have hitherto moved to meet with prominent cases of exception.

Among the several compounds of carbon and hydrogen which have passed through our hands this evening, we remember the two simplest, *marsh-gas* and *olefiant gas*. In the marsh-gas molecule CH_4, we have the carbon atom completely saturated with hydrogen; by the entrance of a second carbon atom, with its two accessory hydrogen atoms, we saw the molecule of marsh-gas, or hydride of methyl, converted into the molecule of hydride of ethyl C_2H_6.

The formula of olefiant gas, C_2H_4, places its molecule midway between the molecules of marsh-gas and hydride of ethyl. Comparing olefiant gas with marsh-gas, we find that it contains one of carbon more than the latter, the number of hydrogen atoms being equal in both substances. Contrary, then, to the rule on which we hitherto relied, we find that the carbon atom, transforming the marsh-gas molecule into the molecule of olefiant gas, enters *without* carrying along the two atoms of hydrogen, which we had accustomed ourselves to consider as the inseparable companions of the carbon atom on such occasions. While frankly admitting that in olefiant gas we meet with the first exception to a rule hitherto unbroken, we are entitled to inquire whether there are no means of explaining this anomalous construction of the olefiant gas molecule. Let us again apply to the models which, in a measure, have assisted us in constructing the rule; perhaps they may help us also in elucidating the exception.

In building up the molecule of olefiant gas by the insertion into the marsh-gas molecule of one atom of carbon only, we obtain what hitherto we would have called an *unfinished* molecule,—*i.e.*, a molecule in which two of the attraction units of the second carbon atom are unsatisfied. Indeed, a glance at our model shows us that two carbon arms project uncovered. We are thus led to inquire whether unfinished molecules—*i.e.*, molecules in which a certain number of attraction units remain unbalanced—are capable of a separate existence. This question is accessible to experiment. Olefiant gas, indeed, possesses all the characters which, granting for argument's sake the possibility of its existence, we are inclined to attribute to an unfinished molecule. In the cases hitherto considered, we saw the chlorine atom, when admitted into a molecular structure, always entering *with substitution*, hydrogen separating from the chlorinetted molecule in the form of hydrochloric acid. In this manner we succeeded in transforming the marsh-gas molecule successively into monochlorinetted, di-, tri-, and, lastly, tetrachlorinetted marsh-gas or tetrachloride of carbon. Submitting, on the contrary, olefiant gas to the action of chlorine, we find that the chlorine is fixed *directly*, *without substitution*, the chlorine atoms meet, so to speak, with vacant spaces existing in the olefiant gas molecule; in order to get in, they need not expel a corresponding number of hydrogen atoms to make room for them. The compound generated is the so-called *Dutch liquid*, an oily substance first produced by an association of Dutch chemists at the close of the last century. It was the production of this oily liquid that gave rise to the name of *olefiant gas*. The number of chlorine atoms thus received directly without substitution is *two*, corresponding exactly with the number of attraction units that remained unsaturated. Any further number of chlorine atoms are found to enter by substitution, and by substitution only. Similar phenomena are observed when olefiant gas is brought into the presence of bromine. We have here a large glass vessel containing some bromine and water; the vessel, by means of a flexible tube, is connected with a gas-holder filled with olefiant gas. On agitation, we see the olefiant gas rushing into the vessel as into a *vacuum*. The olefiant

Fig. 20.



Marsh-gas. Olefiant Gas. Dutch Liquid.

gas fixes two atoms of bromine, being converted into a transparent colourless liquid, the substance called *dibromide of olefiant gas*. Here, again, the combination takes place without substitution.

The behaviour of olefiant gas, under the influence of chlorine and bromine, elucidates the nature of its molecule. The facility with which this gas is capable of fixing two atoms of chlorine to become Dutch liquid, two atoms of bromine to become bromide of olefiant gas, and by roundabout processes two atoms of hydrogen to become hydride of ethyl—all three finished molecules—characterises olefiant gas as a molecule interrupted in its growth, and in which the power of resuming this growth, and the limit of its final development may be traced by the simplest experiments. The apparently anomalous construction of the olefiant gas molecule is thus most satisfactorily accounted for. Indeed, far from disturbing the harmony of the rules of combination elicited by our inquiries, a closer examination into the nature of this compound, whilst explaining whatever appeared exceptional in its construction, leads us, on the contrary, to a loftier interpretation of these rules, to the conception of compounds, the very structure of which foreshadows the more prominent features of their chemical character.

I have selected olefiant gas as an example of a class. We remember that this substance is the first term of a long list of homologous bodies, in all of which we find similar structure combined with similar chemical properties. All these substances, and, let me add, a great variety of others, we have to regard as molecules arrested under special circumstances at a certain stage of their development, but capable, under favourable conditions, of growing again, until by the perfect balance of the atomic attractions within they have ultimately arrived at maturity.

We have thus been led, step by step, to a distinction of a novel kind, that of *finished* and *unfinished* molecules; or, to use the more frequently employed expression, that of *saturated* and *non-saturated* compounds. I need not tell you that this distinction carries us to the threshold of a new field of research, hitherto crossed only by a small band of fearless pioneers, who are encountering difficulties on all sides. Admitting, as we are compelled to do, the existence of what we have called unfinished molecules, we inquire under what special conditions, at what special stages the growth of a molecule may be arrested. How is it that as yet the marsh-gas molecule is known only in the finished state, CH_4, that none of the fragmentary marsh-gases, CH_3, CH_2, and CH_1, which might exist, have ever been obtained? Again, how is it that the molecule of hydride of ethyl exists, so to speak, finished and unfinished; and, lastly, that of the several fragmentary states in which this molecule might be met with, two only—namely, the two states C_2H_4 (olefiant gas), and C_2H_2 (acetylene)—have ever been observed? We are thus brought face to face with some of the most deeply interesting problems of chemical mechanics, in the solution of which the exertions of chemists are engaged at the present moment. I must not, however, dwell upon the interest attached to this new line of inquiry, upon the numerous experiments which the idea of saturated and non-saturated compounds has already suggested, and on the influence it is likely to exercise on the direction of chemical investigation for some time to come.

Nor am I permitted to follow these speculations into another direction. I have to forego, more especially, the pleasure of submitting to you some of the ingenious explanations which Professor Kekulé, to whom we are greatly indebted for the development of this branch of chemistry, has advanced for the elucidation even of *saturated* compounds of anomalous constitution. Tempting though the further elaboration of this subject may appear, it would lead me inevitably beyond the legitimate limits of a Friday evening lecture at the Royal Institution.

Indeed, my time, and I fear your patience, are exhausted, and I must add but few concluding words. Your attention so kindly bestowed on my remarks will not, I trust, have been entirely thrown away if I have succeeded in convincing you that modern chemistry is not, as it has so long appeared, an ever-growing accumulation of isolated facts, as impossible for a single intellect to co-ordinate as for a single memory to grasp.

The intricate formulæ that hang upon these walls, and the boundless variety of phenomena they illustrate, are beginning to be for us as a labyrinth once impassable, but to which we have at length discovered the clue. A sense of mastery and power succeeds in our minds to the sort of weary despair with which we at first contemplated their formidable array. For now, by the aid of a few general principles, we find ourselves able to unravel the complexities of these formulæ, to marshal the compounds which they represent in orderly series; nay, even to multiply their numbers at our will, and in a great measure to forecast their nature ere we have called them into existence. It is the great movement of modern chemistry that we have thus, for an hour, seen passing before us. It is a movement as of light spreading itself over a waste of obscurity, as of law diffusing order throughout a wilderness of confusion, and there is surely in its contemplation something of the pleasure which attends the spectacle of a beautiful daybreak, something of the grandeur belonging to the conception of a world created out of chaos.

PHARMACEUTICAL MEETING.

Wednesday, October 4.

Mr. Peter Squire *in the Chair.*

This, the first meeting of the season, was as usual devoted to the distribution of the prizes gained by the pupils of the Society during the past session. The Professors presented their Reports, and the Chairman distributed the prizes with a few words of advice and encouragement to the receivers. The names of the prize-men are as under:

Chemistry and Pharmacy.

Medal	Mr. A. R. Hall
Certificate of Merit .	„ F. Oldfield
„ „ .	„ F. C. Clayton

Botany and Materia Medica.

Medal . . .	Mr. F. Oldfield „ G. W. Self (equal)
Certificate of Merit .	„ F. C. Clayton
„ „ .	„ S. Applegate
„ „ .	„ H. W. Harris
„ „ .	„ J. A. Thomas

Practical Chemistry—Laboratory Class.

Medal	Mr. A. Rose
Certificate of Merit .	„ F. C. Clayton
„ „ .	„ H. W. Harris
Pereira Medal . .	„ A. Rose

Prizes for Herboria.

Silver Medal . .	Mr. J. W. White
Honorary Certificate .	„ Isaiah Tansley

Jacob Bell Scholarships.

There was no candidate this year for the Senior, so the Council allotted two Junior Scholarships. These were gained by Mr. A. R. Hall and Mr. S. Applegate.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, October 3, 1865.

Edward Schunck, *Ph.D., F.R.S., &c., Vice-President, in the Chair.*

A paper was read "*On the Internal Heat of the Earth as a Source of Motive Power,*" by Mr. George Greaves, M.R.C.S. It has been very generally admitted that coal will not cease to be furnished because of the exhaustion of the stores of the mineral now existing in the coal measures; and further, that the obstacles to the continued working of the mines will not be engineering difficulties. The increased depth from which the coal will have to be brought may add to the cost, but at that increased cost it will still be for a long time obtainable. The author considered the real insurmountable obstacle to be the high temperature of the lower portions of the carboniferous strata. That temperature had been shown to be at a depth of 4000 feet at least 120° Fahr., a degree of heat in which human beings cannot exist for any length of time, much less use any exertion. It had occurred to the author to inquire whether the very agency which will prevent the continued supply of fossil fuel might not be made the means of rendering that supply unnecessary—whether, in short, the internal heat of the earth might not to some extent be utilised. One or two modes of doing this had presented themselves to his mind. One of these might, he conceived, be the direct production of steam power by bringing a supply of water from the surface in contact with the heated strata by means of artesian borings or otherwise.

ACADEMY OF SCIENCES.

October 9.

M. de Chancourt presented a memoir "*On the Allotropic Conditions of Iron.*" The author, like Berzelius, recognises two allotropic states of this metal, and adopts the same names for them—*ferrosum* and *ferricum.* Ferrosum is the metal from ores containing protoxide; ferricum is obtained from the anhydrous peroxide ores. The most characteristic form of ferrosum is the white crystalline cast iron (*Spiegel Eisen*), commonly obtained from the carbonate, and is best produced at a low temperature. This form of iron has a strong affinity for carbon. Chemically it must be classed among the bodies which unite with one atom of oxygen. Ferricum also combines with carbon at high temperatures, but deposits it again on cooling. This form of iron gives the malleable metal, and also blistered iron. The author states that while ferrosum easily passes into ferricum, the inverse change cannot be effected. Ferricum belongs to that class of bodies which combine at least with three atoms of oxygen and often more, but always an uneven number of atoms. This memoir will have considerable interest for metallurgists, and we shall therefore give it at length.

M. Bultinck presented a note "*On the Use of Magnesium in Voltaic Piles in Place of Zinc.*" Our readers can imagine the results. The author shows that a short chain of twenty elements, each composed of thirty-five millimetres of thin silver and magnesium wires, wound about pieces of caoutchouc and properly connected, will produce all the effects, chemical, physical, and physiological, of a long Pulvermacher's chain when simply moistened with pure water.

M. Jennet presented a note "*On the Clarification of Peaty Waters by Alum.*" Most of our readers will have heard of a method of clarifying and rendering portable certain muddy waters by stirring or shaking up with them a very small quantity of finely powdered alum. Then, after standing a few minutes, the suspended impurities deposit, and the water becomes perfectly bright, and at the same time extremely palatable. The explanation of this is as follows:—In dissolving, the alum splits up into sulphate of potash and sulphate of alumina. The former remains in solution in the water; the latter decomposes, and the insoluble alumina unites with and carries down the suspended organic impurities; while the sulphuric acid acts on the alkaline and earthy carbonates, forming sulphates and setting free carbonic acid. The biphosphate of alumina, although slower in its action, the author thinks would be a better clarifier if the carbonic acid set free did not dissolve some of the neutral phosphate. Some persons will, perhaps, see a recommendation in what the author considers an objection.

Cholera is still the subject of many communications. In one of these M. R. De Wouves says that the premonitory diarrhœa should always be treated with a purgative to procure the expulsion of peccant matter in the intestines. In another M. G. Grimand gives a succinct history of the recent outbreak in Marseilles, which seems to prove conclusively the fact of the importation of the disease from Alexandria.

NOTICES OF BOOKS.

Dublin International Exhibition of Arts and Manufactures: Reports of the Juries, and List of the Awards. Dublin: 1865.

The reporter on Section II. is Mr. Tichborne, who kindly furnished us with notes on this part of the Exhibition; we have consequently but little to add now on the subject. There are, however, some remarks by Dr. Maxwell Simpson, on the articles exhibited by Henner and Co., of St. Gall, Switzerland, which some of our readers may thank us for extracting. The firm exhibited some chemical products which are difficult to find in commerce. These were found to be what may be termed very fair commercial specimens; and Dr. Simpson remarks that "it offers great facilities for original research that such substances can be procured in small quantities and at reasonable prices. Amylene (C_5H_{10}) was one of the substances examined. Almost the entire quantity taken distilled over between 35° to 45° C. The distillate on being agitated with a solution of chloride of iodine, yielded chloro-iodide of amylene ($C_5H_{10}ClI$) a new body, an account of which has not yet been published. The iodide of allyle (C_3H_5I) is also a good product, the greater part distilled over between 100° to 106° C.; on being agitated with metallic mercury it became a mass of yellow crystals, the mercuro-iodide of allyle $[(C_3H_5)Hg_2I]$. The butylic alcohol distilled over between 104° to 120° C., and treated with iodine and phosphorus, yielded iodide of butyle, the boiling-point of which was about 121° C."

In the Report on Section IV. we find an account of "wood-stuffs" for paper-making, prepared by Roether, of Cassel. The samples were made from four woods, the linden, aspen, pine, and Scotch fir. The best qualities of these, it seems, can be sold for 13s. and 16s. the 110 lbs. "The samples of papers," says the Report, "made from mixtures of rags with different proportions of these 'stuffs' are excellent, and show a decided progress in wood paper manufacture since 1862. Among them may be specially mentioned a good writing paper containing 45 per cent. of Scotch fir stuff; an excellent lapping paper containing 65 per cent.; and a coloured lapping tissue paper which is exceedingly strong, containing 50 per cent. of wood-stuff." These articles and the process by which the stuff is produced, deserve the notice of our manufacturers; but no account of the process is given in the Report.

The Report on Section XXX., Photographs, furnishes us with a very good account of Mr. Swan's casket portraits, an ingenious novelty which deserves notice:—

"One of the most curious novelties in the photographic exhibition is the production of what is called 'casket portraits,' specimens of which are contributed by Mr. Swan, the inventor. For such a really ingenious, original, and scientific contrivance, it seems that the author might have found a more appropriate name, designating more properly the principles upon which it is based, and the manner of its construction. It is, in fact, neither more not less than a real stereoscope, in a different form from that well-known instrument.

"Without being conscious of it the observer has before his eyes, as in the ordinary stereoscope, a picture composed of two different photographs super-posed, each one separately visible to one eye and invisible to the other. These two pictures, placed at right angles on the two sides of two rectangular prisms, with their hypothenuses in contact forming a quadrangular block of glass, are covered to the eye, one from the back surface by refraction, and the other from its hypothenuse by reflexion, after having been refracted upon it by the other prism. By the optical law of the angle of incidence and reflexion the reflected image is seen only by one eye, the axis of which coincides with the reflected ray, and is invisible to the other eye; and by the law of refraction the other image is seen only by the eye, the axis of which coincides with the refracted ray, and is invisible to the other. So that when the observer is placed exactly in the position from which each eye has the exclusive perception of the image, whose perspective belongs thereto, the two images coalesce on the two retinæ, and the stereoscopic perception is brought out in all its beauty and force. The only defect of the apparatus is, that the observer is obliged to find the exact position from which the phenomenon takes place exclusively, and if he lose that position, by the slightest movement of the head, he sees only one or the other image, and there is no illusion of relief, the picture having the flatness of the single photograph which represents it. Notwithstanding that imperfection, Mr. Swan has succeeded in contriving a most ingenious instrument, which elegantly illustrates a very extraordinary phenomenon of optics."

For the rest, this Report contains little beyond some trite remarks on the choice of subjects by photographers, and very fair criticisms of the specimens exhibited. Of the magnesium light it is suggested that it will be found extremely advantageous by the Esquimaux when they take to amusing themselves with photography during their long and sunless winter.

Resumé Oral du Progrès Scientifique et Industriel. Par M. l'Abbé Moigno, &c. &c. Paris, Giraud. June, July, August, and September, 1865.

The monthly conferences of the Abbé Moigno render an essential service to all in Paris who take an interest in the progress of science and its applications. It is not enough to read of new discoveries and inventions, especially those of a mechanical kind. Nor do drawings always assist to a perfect comprehension of a description. The eye requires to see the thing itself, and therefore the demonstrations of the learned Abbé give perhaps the greatest value to his conferences. Nevertheless these little books, in which the author reproduces his discourse, illustrated as often as possible with drawings to accompany his descriptions, will be read with interest all over the world. The contents are of the most varied character. Nothing having the smallest scientific interest seems to escape the notice of the author. In astronomy and therapeutics, in physiology and photography, he is equally at home. An apple that will keep two years, and bones and flint instruments which have kept nobody knows how long, alike command attention; and the reader is presented with an *olla podrida* of science and gossip which he is sure to devour with a relish, and will probably imitate Oliver Twist in asking for more of.

We must strongly recommend these little books to the notice of our readers. They are issued at a very cheap rate, and they will be found to contain a description of almost every novelty in the practical applications of science produced or discovered in any part of Europe.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

2142. J. Bernhard, Rue de l'Echiquier, Paris, "Improvements in the manufacture of artificial saltpetre."—A communication from J. V. P. Lagrange, Rue de l'Echiquier, Paris.—Petition recorded August 19, 1865.

2290. T. C. Gibson, Stamford, Lincolnshire, "Improved machinery for mixing or grinding ointment, paint, drugs, and other substances."—Sept. 6, 1865.

2335. J. Holliday, Huddersfield, "Improvements in preparing certain colouring matters."—Sept. 12, 1865.

2340. J. Dunbar, Victoria Street, Westminster, and J. W. Butler, Dunmow, Essex, "An improved apparatus for the distribution of perfumes, disinfecting or other fluids."—Sept. 13, 1865.

2350. T. Bell and T. L. Bell, Plaistow, Essex, "Improvements in apparatus used for calcining and wasting copper and other ores and substances containing sulphur."—Sept. 14, 1865.

2424. A. Schultz, Rue de l'Abbaye, Montmartre, near Paris, "Improvements in the manufacture of colouring matter, and in the application thereof to dyeing and printing."—Sept. 22, 1865.

2440. G. E. Rolland and E. L. Rolland, Paris, "An improved liquid composition for cleansing, scouring, and bleaching textile, animal, mineral, and vegetable substances."

2444. J. Player, Norton, Stockton-on-Tees, "Improvements in the manufacture of balls, blooms, or slabs of malleable iron or steel."—Sept. 23, 1865.

2472. G. Eveleigh, Southampton, "Improvements in the manufacture of paper by the introduction therein of a new vegetable fibrous substance."

2480. J. Boffey, Sheerness, Kent, and C. W. Smith, Buckingham Street, Strand, "Improvements in compositions used for coating metallic surfaces."—Sept. 27, 1865.

2501. W. Schofield, Heywood, and J. Smith, Baxenden, Lancashire, "Improvements in machinery and apparatus for bleaching, soaping, clearing, and washing fibrous and other materials, yarns, and fabrics."

2505. J. Duke, Puriton, near Bridgewater, Somersetshire, "Improvements in the manufacture of cement."

2507. J. Addenbrooke, G. Addenbrooke, and P. A. Milward, Darlaston, Staffordshire, "Improvements in collecting or drawing off the gases from blast furnaces."—Sept. 29, 1865.

2527. S. C. Salisbury, New York, U.S.A., "Improvements in producing and combining gases to be used for heating purposes, and in the construction of retorts for producing and combining such gases."—Oct. 2, 1865.

2535. R. A. Brooman, Fleet Street, London, "Improvements in apparatus for decomposing and superheating liquids, vapours, and gases."—A communication from G. Renard, St. Ouen, and A. Lipman, Paris.

Notices to Proceed.

1480. J. Hibell, Nechells, near Birmingham, "Improvements in annealing pots and saucers, for annealing iron and steel wire, sheet metal, and other articles."—May 30, 1865.

1506. H. Allman, Ampthill Square, Middlesex, "Certain improvements in the manufacture of iron and steel, and in apparatus connected therewith."—June 1, 1865.

1515. H. Allman, Ampthill Square, Middlesex, "Certain improvements in the means employed for the prevention of the ignition of matter capable of ignition or combustion."—June 2, 1865.

1582. R. A. Brooman, Fleet Street, London, "Improvements in kilns for firing porcelain and other ware."—A communication from F. Durand, Paris.—June 10, 1865.

1711. R. A. Brooman, Fleet Street, London, "An improved method of, and apparatus for, burning liquid hydro-carbons, and the employment thereof for heating purposes."—A communication from A. Schpakofsky and N. Stange, St. Petersburg, Russia.

1743. W. E. Newton, Chancery Lane, "Improvements in preventing the incrustation of steam boilers."—A communication from C. J. Eames, New York, U.S.A.—June 29, 1865.

CORRESPONDENCE.

Explosions in Veins of Lead Ore.

To the Editor of the Chemical News.

Sir,—I have often heard it stated that even the polished sides (slicken sides) of the veins of lead ore in Derbyshire limestone will explode more or less violently when they are scratched or struck with a hammer. In the lead districts I have recently visited in Germany, where the ore traverses greenstone and schists, as well as limestone and barytine, I could obtain no account of such explosions. Sir Charles Lyell says of the Derbyshire veins: "When one side of the vein stuff is removed, the other side cracks, especially if small holes be made in it, and fragments fly off with loud explosions, and continue to do so for some days. . . . These phenomena and their causes (probably connected with electrical action) seem scarcely to have attracted the notice which they deserve." Can any of your numerous readers supply the results of their observations on this point, or suggest any theory of these remarkable explosions? I am, &c.,

T. L. Phipson, Ph.D.

44, The Cedars, Putney, October 16.

Baron Seguier's Experiment on the Incompressibility of Water.

To the Editor of the Chemical News.

Sir,—Some short time back, Baron Seguier demonstrated the incompressibility of water by taking a glass cylinder and plunging it into water, and letting a leaden ball drop within it. I have found that a sphere does not succeed so well as an elongated spheroid, or a cylinder of brass or any other metal, with one end filed to a point, and the cylinder allowed to fall with the point first. This experiment, of course, is only a modification of Professor Faraday's, performed at the Royal Institution some few years back.

In the memoirs of the Royal Academy of Sciences of Paris, tome 10th, anno 1693, page 397, will be found a theory advanced by M. De la Hire, accounting for the resistance of air and water to sudden motion, which, I think, satisfactorily accounts for the above experiments. He observes "that the resistance to motion is by so much the greater as the motion is the more sudden; and when it is so to such a degree that what resists has not the time to recede, then a body, very weak of itself, may supply the place of one that is immoveable, and of an invincible obstacle. It is for this reason that air and water, struck with such velocity, and with so sudden a blow that they have not time to recede, become fixed points,—the one for the flight of birds, the other for the action of oars." This theory is at once both conclusive and reasonable, and the experiments of Faraday and Seguier only serve to prove the verity of De la Hire's theory; and, therefore, the modern theory accounting for their experiments is superfluous, and, of course, unnecessary; for when the surface of water is suddenly struck, the point of contact is, for the time being, an immoveable fixed point; and when the water is enclosed in a glass cylinder, the body with which the water is struck is retained for a conceivable space of time on the surface of the water; the water then gradually rises between the sides of the striking body, which allows the body to sink; but if the body strikes with much greater force than will allow the water to have time to rise, the water seeks another direction, and consequently splits the glass. Should the body be an elongated sphere, or a cylinder with the lower end pointed, then the force required to split the glass tube is not so great, for the tapering end, acting as a wedge, passes or penetrates the water much quicker than a sphere would. Of course, the length of the wedge bears a relation to the force exerted.

Should you favour me with an insertion of this letter, I shall feel greatly obliged, and perhaps it might prove interesting to a few, at least, of your readers.

I am, &c. Jeremias.

MISCELLANEOUS.

Royal Polytechnic Institution.—Some recent changes have been made in the entertainments at this Institution which deserve notice. Professor Pepper has introduced a lecture on polarised light and the phenomena of diffraction, in the course of which he gives a very clear exposition of the theory of light and the phenomena in question, and we need hardly say exhibits some most beautiful experiments. Mr. King describes the thermo-electric battery, illustrating his description by experiments with a large pile on Marcus' principle. Some new ghost scenes have been introduced, and this part of the evening's amusement has been made more attractive than ever. There is plenty of other entertainment provided for those who, without being necessarily "dull fools," are yet unable to see "how charming is divine philosophy." The excellence of Mr. Pepper's lecture on light induces us to ask whether it would not be possible to give a higher educational value to the lectures at the Polytechnic by the delivery of short courses on chemistry and different branches of natural philosophy, similar, we may say, to the Christmas juvenile lectures at the Royal Institution. Illustrated as the lectures always are at the Polytechnic, each one would be entertaining to the occasional visitor, while giving to the regular attendant some real knowledge of science. We throw out this suggestion for Professor Pepper's consideration when he is thinking over his holiday programme.

Results of the Explosion of Nitroglycerine.—The new blasting material is a light-yellow oily fluid—a compound of glycerine and nitric acid, its chemical formula being $C_6H_5O_3(NO_5)_3$, which gives 18 parts of oxygen; and Mr. Nobel claims that as by combustion the carbon takes 12 atoms of oxygen, and the hydrogen 5, its complete combustion leaves a surplus of O_1 only. He states, moreover, that each 100 parts of exploded blasting-oil leaves a residue of—carbonic acid, 58; water, 20; oxygen 3½; and nitrogen, 18½ = 100; and that as the specific weight of the oil is 1·6, one volume produces nearly 1300 volumes of gas—that is to say, steam, 554; carbonic acid, 469; oxygen, 39; and nitrogen, 236 = 1298 volumes. Weight for weight, the blasting-oil bears very favourable comparison with gunpowder, which is calculated to produce ordinarily about 250 volumes of cold gas only; the nitro-glycerine would, consequently, appear to be, other things being equal, about five times as effective as gunpowder. But Mr. Nobel goes further than this, for he remarks that it is difficult to determine the degree of heat produced by an exploding substance, and that, according to theory, the blasting-oil, on account of its complete combustion, ought to develope a more intense heat than gunpowder, and this appears to be borne out by experiment; whence he assumes that the heat developed by the explosion of nitro-glycerine is twice that generated by gunpowder, and from this calculates that nitro-glycerine, compared with gunpowder, possesses about 13 times its power, when volumes are considered, and 8 times its power for equal weight; and that owing to its rapidity of explosion its advantages are still greater.

Sale of Capsuled Articles.—At the meeting which we announced, and which took place at the house of the Pharmaceutical Society, Bloomsbury Square, on October 5, the following resolutions were moved and carried:—1. "That the Patent laws, as illustrated by recent Chancery suits respecting capsuled articles, are injurious to trade in general, and especially embarrass international and retail trade, and should be amended." 2. "That a petition embodying the foregoing resolution, and detailing the proceedings referred to, and also praying the amendment of the Patent laws, be prepared and presented to Parliament." These resolutions, it must be admitted, go to the root of the matter; but the remedy which they suggest for present grievances will probably be withheld for many a year.

We believe that when the question is tried the retailer will be held blameless, a belief which is greatly strengthened by the speech of Mr. Flux (the solicitor) at the meeting. We extract some portions of this address from the report of our contemporary, *The Chemist and Druggist*:—Mr. Flux (solicitor to the Pharmaceutical Society) said that as Mr. Hills had asked him whether the suits which Mr. Betts had commenced were to be tried, he thought it only right to say that a great many gentlemen had done as Mr. D'Aubney had done. They had taken eminent advice, and acting on it they had compromised their suits, probably paying handsome sums and costs, thereby affording encouragement to Mr. Betts to pursue his system from one end of the country to the other. He could not with unbounded confidence say that these suits could be successfully defended, but he could say that he defended them with a fair amount of confidence as to the ultimate result. According to the *reductio ad absurdum* of the Patent laws, Mr. Betts might have a *primâ facie* case in a court of equity, so that he might possibly succeed in getting a decree; but if he did, it would be, to the best of his (Mr. Flux's) belief, but a naked decree, without costs, against the defendant, who would perhaps have to pay his own costs, because any damages would be of such a ridiculously small amount. A Vice-Chancellor would probably say that Mr. Betts ought not to have gone to court systematically, as he had done, with such a large batch of bills; about twenty-five, all struck off in blank as it were, the only change being the substitution of one gentleman's name for another. So much for Mr. Betts's form of proceeding. But now, looking at the whole matter, he should be able to prove that which perhaps was unknown to other professional gentlemen who had advised on this matter. Mr. Betts had not a patent for capsules, but for metal of which capsules could be made. He should be able to prove conclusively that Mr. Betts had not only sold large quantities of his metal, but millions of capsules made of his metal, without any distinguishing mark being put upon them; and it was within his own knowledge that Mr. Betts's own agent could not tell, when a capsule was placed in his hands, whether they were made by him or not. Mr. Betts's confidential agent was one day in his (Mr. Flux's) office; and by way of parenthesis he might say that he then believed that they had come to an amicable termination of the matter, and that it would have been a drawn battle and peace would have been established; but it was impossible to say in connection with these matters when they had arrived at a conclusion, and he now believed they would have to fight to the end. On the occasion referred to, they discussed the possibility of distinguishing between a genuine and what was not a genuine article. He (Mr. Flux) had had supplied to him, and with the means of proving it, Betts's plate and his capsules. He placed them in Mr. Campbell's hands, and said to him, "Tell me, are they Mr. Betts's manufacture or not?" Mr. Campbell turned them over and over again, and said, "If I had a microscope, perhaps I could tell." (Laughter.) He then said to him, "Then if that be the case, tell me how an outsider can say that these are Betts's capsules or not." (Hear, hear.) To which he replied, "Perhaps they cannot tell." (Laughter.) He repeated his question, "Tell me, without a microscope, are they Betts's manufacture or not?" and he replied, "They are not." (Hear, hear.) Upon which he (Mr. Flux) said, "Then I can prove most distinctly that they are." ("Hear, hear," and laughter.) Now, in the course of such a proceeding as that, and in the face of his having sown broadcast over this and foreign countries capsules of his manufacture without the slightest distinguishing mark, it occurred to him (Mr. Flux), that to prove that the capsules proceeded upon were an infringement of the patent would be a very difficult thing for Mr. Betts to do; and at any rate it would be capable for the defendants to show that in selling these capsuled articles they acted in perfect innocence, and that they were in a trap which Mr. Betts himself had laid for all the world—he did not mean to say openly and purposely—but which, nevertheless, was in effect a trap into which the retailers had fallen. In the face of that, and according to the law of justice which he had ever seen administered in the Court of Chancery, he could not see how the defendants could be cast in costs, and he had a strong conviction that Mr. Betts would have to pay them. So much, then, for the matter that had been referred to him by Mr. Hill's question; and he would say a few words with reference to the proposition before the meeting. Mr. Betts's patent was not, as he had before said, for capsules, but for the metal of which they were made. In the ordinary retail trade he did not think they could take up an article in any one of their shops that might not, for what they knew, expose them to a Chancery suit in half a dozen different directions. The capsule on the top of the bottle might expose them to a suit in Chancery, not because of its being a capsule, but because it was made of a given metal. The pot, the label, even the paper, and the colour of the ink might be covered by patent or registered designs, and render them liable to as many Chancery suits; and really if such suits as these could prevail, they could not conduct the ordinary retail trade of the country with any amount of safety. Now, with regard to the international part of the question. Take, for instance, Vichy water. By the law of France, he believed, Vichy water must be capsuled.—Mr. Hills said it was now covered with tin. They had given up the use of the composition.—Mr. Flux: By the law of France Vichy water must be capsuled, but if by the law of England it could not be imported with capsules—without capsules it would be contraband leaving France, with capsules it would be contraband touching the shores of England. There were many articles which were imported from France that were never opened until they got into the consumer's hands, which might be full of explosive matter in the way of Chancery suits. Now, let them look at the question as it affected the trade in various portions of Great Britain. Betts's patent did not extend to Scotland. Messrs. Tennant, of Scotland, manufactured bottled beer, which they fastened down with metallic capsules, and sent direct from Scotland to India they did not infringe the patent by the use of the capsules; they, however, received an order, the other day, for some beer to be sent to a foreign port, and as there was no steamer direct from Glasgow to that port, the beer was sent to Liverpool for transhipment to its destination. Now, by its arrival in the port of Liverpool, although it was never intended to be consumed within the realm, it was contraband. A Chancery suit had been commenced, and no doubt the injunction would be granted; and that being the case, it appeared to him that the resolution was fully supported, and that the patent laws interfered with international trade, and materially embarrassed the retail trade.

ANSWERS TO CORRESPONDENTS.

TO OUR READERS.

Dr. Odling's lectures, now nearly completed, will be followed immediately by the Cantor lectures delivered by Mr. T. C. Calvert, F.R.S., "On Recent Improvements in Chemistry as Applied to the Arts."

K. W. D.—It is not possible to effect what our correspondent wishes.

Observer.—Try if you can boil your kettle by setting it over an open bottle of the liquid. Strong ammonia is used in medicine as a counter-irritant.

Subscriber.—Answers according to Fownes and Gregory will be accepted. The next edition of Fownes, which will be issued shortly, will have formulæ on the new and old systems, side by side; if yet another edition of the book should be called for, it has been decided to reconstruct the book on the new system. The second question we are unable to answer, not having this year's regulations at hand.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Qualitative Analysis of Substances Insoluble in Water and Acids, by Chas. L. Bloxam.

(Continued from page 138.)

Examination of Insoluble Substances for Alkalies.—The ordinary process of fusion with baryta for the detection of alkalies is attended with some inconvenience. The baryta itself is not a pleasant reagent, and it is not always easy to obtain it free from alkalies. If the fusion be performed in platinum, the metal is slightly attacked; if in porcelain, there is danger of introducing alkali from the glaze, which is always affected. The fused mass is generally difficult to detach, and is so slowly attacked by water that it has to be dissolved in hydrochloric acid, which involves the separation of a large quantity of baryta, as well as of magnesia, before seeking for the alkalies. I have found that the use of a mixture of nitrate of baryta and sulphur obviates these difficulties, and enables the decomposition to be easily effected by the heat of a spirit-lamp.

Nitrate of baryta is, of course, easily obtained in a pure state, and flowers of sulphur may be depended upon as free from alkalies.

One part, by weight, of the substance under examination is mixed with one part of flowers of sulphur and six parts of nitrate of baryta; the mixture is introduced into a porcelain crucible, and quickly heated over a spirit-lamp or air-gas flame, until the deflagration is over; about one minute suffices for this. The crucible is allowed to cool, the fused mass loosened at the edge with the point of a knife, and thrown into a mortar, where it is easily reduced to a fine powder. (The glaze of the crucible will be found quite untouched.) The powder is thrown into a little boiling water, in a dish, boiled for a minute or two, and filtered. The filtrate is mixed with ammonia and carbonate of ammonia, and boiled, to separate baryta and other alkaline earths which may be present, and after these have been filtered off, the solution is evaporated, and the examination for alkalies conducted in the ordinary manner.

Flint-glass (5 grains) was examined in this way. The potassium was very readily detected. No potassium was found to have been left in that portion of the fused mass which was insoluble in water.

Felspar (5 grains) gave an equally satisfactory result. In this case, also, no potassium could be found in the residue left by water.

Window-glass (5 grains) gave the sodium precipitate very distinctly with antimoniate of potash, in characteristic strongly-adherent crystals. No potassium was detected.

Cryalite (5 grains) also gave antimoniate of soda very distinctly. No indication of potassium.

The economy of time, fuel, and crucibles, resulting from the application of the processes above described, will be found, I hope, to justify my belief that they are not undeserving of the attention of a society which includes a large number of practical chemists.—*Journal of the Chemical Society*, September, 1865.

Process for the Extraction of Lithium, Cæsium, Rubidium, and Thallium from Lepidolite,[*] *by M.* A. Schrœtter.

The author's process, which may be used on a large scale, consists in, first, simply fusing lepidolite at red heat; it expands greatly in fusing, so that the mass must be frequently stirred; when sufficiently fused pour it into cold water, and pulverise and wash the vitrified mass thus obtained. (The lixivium will contain small quantities of alkaline metals, which will serve for the treatment of another portion.) Treat the washed mass by hydrochloric acid (1 part of lepidolite requiring 2 parts of hydrochloric acid at 1·10 of density). After several hours' boiling, separate the greater part of the silica, and having added nitric acid and peroxide of iron, precipitate by carbonate of soda, so as to diminish the iron, alumina, lime, magnesia, and manganese; the liquid should be so diluted that lithia, the carbonate of which is very little soluble, should not be precipitated. The liquid will then contain only the chlorides of the alkaline metals and a little silica. By evaporating in an iron vessel a little more carbonate of magnesia is separated; then saturate with hydrochloric acid, and add a watery solution of chloroplatinate of potassium, sufficient in quantity to precipitate all the rubidium, cæsium, and thallium. (The quantity to be added should be determined by a previous assay.) The filtered liquid, containing the excess of platinum and lithia, precipitate by sulphuretted hydrogen to separate the platinum, then concentrate and treat it by carbonate of soda; in this way the lithia is precipitated in the state of carbonate.

The advantage of this method consists in the direct fusion of the mineral, and may be applied to all lithion micas. 1000 parts of lepidolite treated in this way will give 78 parts of carbonate of lithia, 6·5 parts of chloride of cæsium and rubidium, and 0·6 of thallium, supposing the operation to be continuous.

On the Combination of Hydrocyanic and Hydriodic Acid, by M. Arm. Gautier.[†]

I proposed to produce phosphocyamine—

$$P\left\{\begin{matrix}Cy\\H\\H\end{matrix}\right.$$

by the action of gaseous phosphoretted hydrogen on iodide of cyanogen. The principal reaction is complicated by secondary reactions, which I have studied for some time.

In the course of these researches I have noticed the production of a compound perfectly free from phosphorus, very little soluble in ether, and which made me suppose the existence of a combination of hydrocyanic and hydriodic acids, formed in the preceding reaction; it is this, in fact, which confirms the direct experiment.

I obtained this combination by causing to arrive simultaneously in a large balloon a current of dry hydrocyanic acid, and one of dry hydriodic acid; the two gases combined immediately at the ordinary temperature into a white amorphous body, precipitated against the sides of the receiver.

In other operations I passed gaseous hydriodic acid into anhydrous hydrocyanic acid, surrounded with ice. The liquid soon solidified into a nearly white mass. The two bodies combine as easily as ammonia and hydriodic acid.

Washing the compound with ether takes from it the excess of hydriodic and hydrocyanic acid, as well as a little free iodine; it is then nearly pure, and may be crystallised in absolute alcohol.

It is a solid body, in white crystals belonging apparently to the rhomboidal system, odourless, and with a fresh, saltish taste, becoming slightly bitter, but not in

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[*] *Journal für Praktische Chemie*, xcii., 275.

[†] *Bulletin de la Société Chemique*, p. 88. 65.

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the least acid; in water and alcohol it dissolves readily, and but very little in ether; it does not seem to attract much atmospheric moisture.

It is infusible, but may be sublimed in dry air without undergoing much decomposition; a small quantity of iodine is set at liberty, with no deposit of carbon; volatilisation seems to take place towards 350 or 400°; but it commences at 180°. Submitted for some time to 150° it becomes greyish and earthy. Exposure to the sun does not alter it.

The analyses hitherto made authorise me to attribute to this body the composition $ꞒNH_2I$, and from its properties it seems to be an iodide of ammonium, in which the triatomic radical $ꞒH$ holds the place of H_3. I will, then, represent this body by the formula—

$$N\left\{\begin{matrix}ꞒH'''\\H\\I\end{matrix}\right.$$

It is evidently the iodide of the most simple of the compound ammoniums.

In this combination all the properties of cyanogen or hydrocyanic acid are entirely lost. The aqueous solution is neutral, or almost so, to papers, but gradually acidifies. Powdered, moistened with a very little water, and heated for some time, it gives crystals of iodide of ammonium, and disengages formic acid, which is deposited in minute liquid drops on the sides of the tube.

It is, however, impossible to find any trace of hydrocyanic acid in the aqueous solution.

The action of the water, then, is thus expressed—

$$N\left\{\begin{matrix}CH'''\\H\\I\end{matrix}\right. + 2H_2Θ = N\left\{\begin{matrix}H_3\\H\\I\end{matrix}\right. + ꞒH_2Θ_2$$

Treated by diluted potash this compound immediately disengages all its nitrogen in the form of ammonia; iodide and formiate of potassium are produced, but no trace of cyanide.

Nitrate of silver also precipitates all the iodine. The iodide is mixed with a white compound soluble in excess of water.

Bichloride of platinum is partially reduced, at the same time that a yellowish crystalline body is formed, which has not yet been analysed.

Hydrobromic acid acts like hydriodic acid on hydrocyanic acid, this combination has not yet been studied; neither has the action of gaseous hydrochloric acid been investigated.

Like the compound above described, hydrocyanic acid, soluble organic cyanides, and metallic cyanides themselves, give, by the action of water and bases, ammonia and formic acid. But in these combinations the cyanogen disappears but gradually, and their solution long retains the characteristic properties of cyanides. It is thus only progressively, and by the prolonged action of water or of bases, that nitrogen and its compounds pass to the ammoniacal type.

In the combination I have described, the cyanogen, on the contrary, has entirely disappeared, and diluted potash immediately disengages all the nitrogen in the form of ammonia, at the same time that it combines with iodine. This is exactly what takes place with hydriodate of ammonia.

Chemical Society.—The next meeting of this Society will take place on Thursday evening next, at 8 o'clock, when Professor Church will read a paper "On some New Cornish Minerals."

TECHNICAL CHEMISTRY.

*The Allotropic Conditions of Iron and their Part in Metallurgy,** *by M.* DE CIZANCOURT.

OXIDES of iron have long been considered as the degrees of oxidation of one metal, which was supposed always to present itself when in a metallic state, with absolutely identical characteristics, if of the same degree of chemical purity or of the same composition. This supposition has given rise to the metallurgic theory still generally admitted. All the differences found in the products of iron are consequently attributed exclusively to differences in the chemical composition. These products are now classed in three groups; cast iron, steel, and wrought iron, merely according to the amount of carbon they usually contain. However, certain cast-irons identical in composition, are so different in appearance and give, when analysed, such different products that practically it is absolutely necessary to distinguish them; on the other hand, there are certain cast-irons of the same composition as certain steels, and even steels which analysis can hardly distinguish from certain irons. In fact, in studying the metallurgic products of iron, the chemical composition is but a secondary consideration.

The really dominant characteristic is the relation existing between the properties of the various products, and the degrees of oxidation of the iron in the ores whence they have been extracted. The expression of this general and unvarying fact has, since M. Leplay's remarkable researches, become a kind of axiom, which may be thus rendered; steel ores produce only steel; or, from each ore its iron.

Berzelius has already classified the different combinations of iron by connecting them with two chemically distinct metals, to which he has given the names of "ferrosum" and "ferricum." It remained to ascertain whether these metals had a real physical existence, and could be found distinct in metallurgy. The discovery of the allotropic conditions served to decide the opinions on the property possessed by at least several bodies, even while presenting the same composition when analysed, of appearing in very different conditions with peculiar characteristics, which they may preserve, even when undergoing certain transformations or combinations.

The facts I am about to disclose show that iron in a metallic form possesses at least two allotropic conditions analogous to those of sulphur and phosphorus. The two principal conditions correspond to those described by Berzelius.

Ferrosum is the metal contained in the ores of protoxide.

Apart from the reductions by hydrogen effected in the laboratory, it has practically never yet been obtained in a state of purity. The metallic state, in which it is best defined and most completely stable, is white crystalline cast-iron (spiegel-eisen), which several ores of protoxide, especially carbonates, produce so readily. It is there combined with a variable quantity of carbon, proceeding from oxide of carbon, for which it possesses great affinity.

Ferrosum, in the state of white cast-iron, may be obtained with so much the more facility, that the reduction of the ore takes place at a lower temperature, and that the product cools more rapidly. This is, then, the condition corresponding to the lowest temperatures—that,

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* *Comptes Rendus*, lxi., 578.

consequently, which the lowest temperatures tend to produce.

Ferrosum changes readily to ferricum (iron of peroxide). This property corresponds to that presented in chemistry by pyrophoric iron and protoxide. It furnishes in this way steel and malleable iron; but, when not arrived at the condition of blistered iron, it retains under these two forms the power, always well determined, of being changed, by the usual metallurgic reactions, from iron to steel and from steel to white crystalline cast-iron.

The physical characteristics of ferrosum when combined with carbon, are hardness and fragility.

From its chemical properties it should be ranked among the bodies which combine with a single atom of oxygen.

Ferricum is the metal of anhydrous peroxide ores. Its metallic type is the iron produced from these ores. It unites with carbon at high temperatures, but the latter is deposited during slow cooling for want of affinity. This condition corresponds to the high temperatures, like that of welding heat.

It gives malleable iron, and as a variation of form, blistered iron; but when alone it cannot pass to the state of steel any more than to white cast-iron—at least, by means of the short reactions which can be effected in metallurgy. This almost absolute impossibility of reverting to the state of ferrosum, except, indeed, with great difficulty and in a very unstable manner, after having existed in the ore in the state of ferricum, corresponds, moreover, to the difficulties in the way of the chemical reduction of peroxide.

Its physical characteristic is the malleability which it loses only on attaining its ultimate form—blistered iron.

Its chemical properties cause it to be classed among the bodies which combine with at least three atoms of oxygen, and more of an odd number.

Black and grey cast-irons are not physical conditions determined by a collection of identical molecules. They are simply ferricum, preserving a part of its properties, and depositing when slowly cooled the carbon with which the reaction had charged it while hot. In grey cast-iron ferricum is generally predominant; in mottled cast-iron the two irons are present with their characteristics; ferrosum gives the white portions and the carbon combined; ferricum gives the grey portions with a carbon deposit.

Malleable irons are formed of mixtures in varying proportions of two irons of different origin, both in the state of ferricum. Ferrosum in this state always partially preserves its hardness and power of returning to its original form, as I have already described. The variety found in the irons of commerce depends on the number of mixtures possible.

The magnetic oxide ores contain the two irons in atomic proportions. These ores give the most stable and perfect steels; hence it may be concluded that steel is produced by the reunion of two conditions of iron, and that it is nearest perfection when it holds the two irons in a closer relation than that which exists in the ores. It is not necessary to consider steel as a new state, for magnetic oxide is formed merely of a combination of two oxides.

The correctness of this definition of steel may be proved by a very easy experiment: a mixture of soft or blistered iron (ferricum) and white cast-iron (ferrosum) operated on before or after fusion, always gives when in right proportions a more or less perfect steel recognisable by tempering.

It must, moreover, be observed that magnetic oxide of iron and magnetic pyrites possess, like tempered steel, permanent magnetism. This property, common to both natural and artificial loadstones, independent of the state of oxide, of sulphide, or of carbide, must then result from the simultaneous presence of two allotropic conditions of iron, which is the only constitutive element common to these very different bodies.

The two allotropic conditions of iron, proceeding from the two oxides, are then present in metallurgy, with a similar system of variations; but they are rendered distinct by a certain number of properties. Besides which, they may go through most of the metallurgic reductions and transformations, without losing their original characteristics, or being confounded one with another. These phenomena present the most complete analogy with the well-known properties of the two tartaric acids, distinguished by the direction in which they deviate from the plane of polarisation.

The study of the calorific capacities of various products furnishes results which prove, between crystalline cast-iron and certain malleable irons, numerical differences too important to be explained by the presence of foreign bodies. I hope that the examination of these calorific capabilities, together with a very simple mode of assay, may furnish a practical process for determining the nature and origin of the irons contained in all the products; their use and value may thus be ascertained. It is, moreover, very desirable that there should be a process for testing the qualities to prevent not only intentional fraud, but also those mistakes which may be committed in the present state of metallurgy.

Verifications of the new principles which I have laid down are to be found in the explanation of even the most obscure phenomena; a series of verifications which I will succinctly indicate, after having made known the laws regulating the action of heat and of reagents in the metallurgy of iron.

PROCEEDINGS OF SOCIETIES.

COLLEGE OF PHYSICIANS.

"*On Animal Chemistry.*" A course of Six Lectures by William Odling, M.B., F.R.S., F.R.C.P.

Friday, May 12, 1865.

Lecture 6.

Uric acid—Its excretion throughout the animal kingdom—History of its chemical examination—Its undecomposibility save by oxidation—Classification of uric acid products into an-ureides, mon-ureides, and di-ureides—Also into carbonic, oxalic, and mesoxalic compounds—Oxidation of mesoxalic into oxalic, and of oxalic into carbonic acid—Ureides formed by an elimination of either one or two atoms of water—Table of uric acid products—Additional intermediate and amidated bodies—Oxalic mon-ureides and di-ureides—Mesoxalic mon-ureides associated with barbituric acid—Mesoxalic di-ureides, including hypoxanthine, xanthine, and uric acid—Their mutual convertibility—Relationship of xanthine to guanine—The pseudo-uric and uroxanic acids—Uric acid viewed simply as a compound of carbonic oxide and urea—Tissue metamorphosis affected by alterative medicines—Activity of loosely combined oxygen—Nitric oxide as a carrier of active oxygen—Comparison between nitric oxide and iodine as oxygenants—Resemblances and differences between iodine and chlorine—Free chlorine more active than iodine, and free iodine more mobile than chlorine—Alterative action of iodine dependent on its chemical mobility—Similar characters of arsenic, mercury, &c.—Effect of alkalies on tissue-oxidation—Conclusion.

Of all the incompletely oxidised products of tissue-metamorphosis, uric acid is, I suppose, the most important, whether regarded from a physiological and pathological, or from a purely chemical point of view. In combination, chiefly with ammonia, it forms the principal urinary constituent voided by insects, land reptiles, and birds. Normally, it occurs but in small proportion in the urine of man, while it is found in yet smaller proportion in that of carnivorous, and can scarcely be said to exist—if, indeed, it does habitually exist—in that of herbiverous and omniverous quadrupeds. According to various authorities, it is to be found constantly in the juices of the human spleen, liver, lungs, and brain. The merest traces of it are also met with normally in blood, but its proportion therein under certain forms of disease, such as albuminuria, and more especially in gout, becomes very appreciable. In certain cases of gout, indeed, all the fluids of the body are more or less saturated with uric acid, and some of them even supersaturated, so as to deposit those well-known concretions of urate of sodium, commonly called chalkstones. I need scarcely refer also to the frequent excess of uric acid discharged from the human kidneys, under greater or less derangements of bodily health, and to its deposition in the form of urinary sediment, gravel, or calculus. As shown by its formula, $C_5N_4H_4O_3$, uric acid consists of only sixteen elementary atoms, and is consequently, as regards its ultimate composition, a far more simple body than many of those we have previously considered. Nevertheless, the problem of its intimate constitution for a long time baffled all attempts at solution, and cannot, even at the present day, be considered as quite satisfactorily unravelled.

Uric acid was discovered in 1776 by the renowned Swedish chemist, Scheele; but it was first submitted to a minute investigation by Liebig and Wöhler, whose efforts resulted in the production and identification among other new bodies of alloxantine, alloxanic acid, dialuric acid, uramile, mesoxalic acid, allantoine, mycomelic acid, parabanic acid, &c., and whose admirable work, published in 1838, forms the broad and sound basis of all our subsequent knowledge. These chemists had been preceded by Brugnatelli and Prout,—the discoverers of alloxan and murexide respectively—and were succeeded more particularly by Schlieper, Pelouze, Fritzsche, Gregory, and Hlasiwetz. To the number of bodies already described, Schlieper added the leucoturic, allituric, dilituric, hydantoic, hydurilic, and allanturic or lantanuric acids,—the last also discovered by Pelouze. In 1853, Gerhardt, in his celebrated "Traité de Chemie," gave a very complete account of the then known uric acid products, and, by dividing them into two well-defined natural groups, simplified very greatly the knowledge of their origins and metamorphoses. Among subsequent workers, Baeyer has increased the list of compounds by his discovery of pseudo-uric acid, hydantoine, violantine, and the violuric and barbituric acids, the last-named being a body of very great interest, and has also thrown considerable light upon the nature of the compounds previously discovered by Schlieper. Moreover, adopting Gerhardt's classification as a basis, and viewing both old and new products from the extreme height of modern doctrine, he has published by far the most complete and connected account of the uric acid group of compounds which has hitherto been given to the world. The scheme which I am about to bring under your notice, and which is, I think I may say, even more comprehensive, does not differ greatly from that of Baeyer in general conception, and is indebted very largely to him for its elaboration. I propose, however, to differ from him in disregarding altogether the molecular arrangement of the different compounds, preferring to limit myself in this, as in previous lectures, simply to questions of origin and relationship.

I have already told you that the great majority of complex organic bodies are built up of the residues of comparatively simple molecules; that hippuric acid, for instance, is constituted of the residues of benzoic acid and glycocine, while tyrosine is constituted of the residues of salicic acid and ethylamine,—the glycocine and ethylamine themselves containing residues of ammonia and of glycolic acid and alcohol respectively. Now, uric acid is evidently built up in a similar manner, and contains the residues of several constituent molecules. But a hitherto insuperable difficulty in determining its exact mode of construction arises from the circumstance of its never having been decomposed into the actual molecules of which its constituent residues are the representatives, but only into the oxidised, or, rather, dehydrogenised, products of these molecules. Add to uric acid an atom of oxygen, so as to burn off two of its atoms of hydrogen, and it breaks up with the greatest ease, though without this additional oxygen it has hitherto proved undecomposible. You will observe from its formula, $C_5N_4H_4O_3$, that uric acid contains five atoms of carbon and four atoms of nitrogen, while urea, CN_2H_4O, contains only one atom of carbon and two atoms of nitrogen. Accordingly, we find that when dehydrogenised uric acid undergoes complete decomposition by an absorption of water, it breaks up into two molecules of urea (containing C_2N_4) and one molecule of a non-nitrogenous 3-carbon acid. Whether, however, the residues of these two molecules of urea, obtainable by the oxidation or dehydrogenation of uric acid, pre-exist in uric acid, the 3-carbon acid alone being the dehydrogenised product, or whether the residue of the resulting 3-carbon acid pre-exists in uric acid, the two atoms of urea being produced by dehydrogenation, there is no evidence to show. The great stability of uric acid under treatment with even strong acids and alkalies is certainly opposed to its containing pre-formed residues of urea, since in all undoubtedly so constituted bodies the residues of urea are removeable or decomposible with the greatest facility. On the other hand, the assumption of pre-existent urea-residues in uric acid very greatly facilitates our conception of its decompositions, and, receiving the general consent of chemists, may, I think, be provisionally admitted by us on the present occasion. Be this as it may, when uric acid is subjected to an oxidising agent in presence of water, it gives up two of its atoms of hydrogen to the oxidising agent, while the dehydrogenised product reacts with water to form mesoxalic acid and urea. Employing chlorine as the oxidising agent, we have the following reaction:—

$$\underset{\text{Uric acid.}}{C_5N_4H_4O_3} + \underset{\text{Water.}}{4H_2O} + \underset{\text{Chlorine.}}{Cl_2} = \underset{\text{Mesoxalic.}}{C_3H_2O_5} + \underset{\text{Urea.}}{2CN_2H_4O} + \underset{\text{Chlorhydric.}}{2HCl};$$

or, supposing the reaction with water to take place after the removal of the hydrogen by chlorine,—

$$\underset{\text{Dehyd-uric?}}{C_5N_4H_2O_3} + \underset{\text{Water.}}{4H_2O} = \underset{\text{Mesoxalic.}}{C_3H_2O_5} + \underset{\text{Urea.}}{2CN_2H_4O}.$$

In the above equations I have represented both atoms of urea to be simultaneously separated from the mesoxalic acid; but in reality their separation is usually effected at two successive stages, thus:—

$$\underset{\text{Dehyd-uric?}}{C_5N_4H_2O_4} + \underset{\text{Water.}}{2H_2O} = \underset{\text{Alloxan.}}{C_4N_2H_2O_4} + \underset{\text{Urea.}}{CN_2H_4O}.$$

$$\underset{\text{Alloxan.}}{C_4N_2H_2O_4} + \underset{\text{Water.}}{2H_2O} = \underset{\text{Mesoxalic.}}{C_3H_2O_5} + \underset{\text{Urea.}}{CN_2H_4O}.$$

We have, you perceive, three mesoxalic compounds, first the non-nitrogenous acid, then the compound of the acid with one atom of urea *minus* $2H_2O$, and lastly, the compound of the acid with two atoms of urea *minus* $4H_2O$, thus:—

$$\underset{\text{Mesoxalic.}}{C_3H_2O_5} \qquad \underset{\text{Alloxan.}}{C_4N_2H_2O_4} \qquad \underset{\text{Dehyd-uric?}}{C_5N_4H_2O_3}$$

Now, by hydrogenising mesoxalic acid, we obtain tartronic acid, $C_3H_4O_5$, and by hydrogenising alloxan we obtain dialuric acid, $C_4N_2H_4O_4$, which two bodies accordingly bear to uric acid the same relation that mesoxalic acid and alloxan bear to dehyd-uric acid, thus:—

Tartronic.	Dialuric.	Uric Acid.
$C_3H_4O_5$	$C_4N_2H_4O_4$	$C_5N_4H_4O_3$;

and, just as our hypothetical dehyd-uric acid yields mesoxalic acid and alloxan, so should actual uric acid yield tartronic acid and dialuric acid.

In reality, however, these bodies have not been obtained by the mere breaking up of uric acid, but only by rehydrogenising the mesoxalic acid and alloxan which result from the breaking up of dehydrogenised uric acid. Despite, however, this flaw in the demonstration, we may provisionally, as I have said, regard the dialuric and uric acids as tartron-ureide and tartron-diureide respectively.

The several bodies I have just mentioned are typical of three well-defined classes of compounds, to one or other of which the immense number of uric acid products are, with but very few exceptions, assignable. We have first the class of simple non-nitrogenous acids, or an-ureides, like the tartronic and mesoxalic acids. Then we have the class of bodies containing a residue of the acid *plus* one residue of urea, or the mon-ureides, such as dialuric acid and alloxan; and lastly, we have the class of bodies containing a residue of the acid *plus* two residues of urea, or the di-ureides, such as uric acid itself. Confining our present attention to the an-ureides, let us consider briefly their derivation and mutual relationship. Mesoxalic acid, then, the most complex non-nitrogenous product obtainable directly from uric acid, constitutes the third term in the following series:—

An-ureides.	
CH_2O_3	Carbonic.
$C_2H_2O_4$	Oxalic.
$C_3H_2O_5$	Mesoxalic.

Oxalic acid, you observe, differs in composition from carbonic acid by one atom of carbonic oxide, CO, in excess; while mesoxalic acid differs in composition from oxalic acid by a further atom of carbonic oxide, CO, in excess. Now, when mesoxalic acid is acted upon by nascent oxygen, O, its excess of carbonic oxide, CO, is removed in the form of carb-anhydride, CO_2, so as to leave oxalic acid, thus:—

$$\underset{\text{Mesoxalic.}}{C_3H_2O_5} + \underset{\text{Oxygen.}}{O} = \underset{\text{Carb-anhyd.}}{CO_2} + \underset{\text{Oxalic.}}{C_2H_2O_4}.$$

Hence when uric acid is subjected to a more active oxidation than suffices to produce mesoxalic acid, we obtain oxalic acid, which may occur in its simple an-ureide state, or congregated with one atom of urea to form a mon-ureide such as parabanic acid, or congregated with two atoms of urea to form a diureide, such as mycomelic acid, a body having exactly the same relation to oxalic acid that uric has to mesoxalic acid.

Now, just as we can convert mesoxalic into oxalic acid by burning off its excess of carbonic oxide, so may we convert oxalic acid itself into carbonic acid by a precisely similar oxidation, thus:—

$$\underset{\text{Oxalic.}}{C_2H_2O_4} + \underset{\text{Oxygen.}}{O} = \underset{\text{Carb-anhyd.}}{CO_2} + \underset{\text{Carbonic.}}{CH_2O_3}.$$

The rapidity with which the oxidation of oxalic acid can take place is easily capable of experimental illustration. In this tall beaker, for instance, I will place some ordinary black oxide or peroxide of manganese MnO_2, a compound which readily parts with one of its two atoms of oxygen to become converted into protoxide of manganese MnO; while in the flask I will place an ounce or so of commercial oxalic acid. Now, upon drenching the acid with hot water and pouring the mixture of solution and crystals upon the oxide of manganese, we get, you perceive, a most rapid oxidation of the oxalic acid, accompanied by a violent effervescence of carb-anhydride which we shall be able to recognise in a minute or two by its high specific gravity and by its power of extinguishing flame and of rendering lime-water turbid. The effervescence is at first so great as to be almost unmanageable, and a very slight agitation would cause the liquid contents to froth over the beaker, but now that the action is a little moderated I may prove to you the nature of the gas evolved by pouring some of it on to a lighted taper, which you see is immediately extinguished, and by pouring some more of it on this clear lime-water, which by agitation therewith is immediately converted into an opaque mixture of chalk and water. Accordingly, when uric acid is subjected to a more powerful oxidation than suffices to produce oxalic acid, we obtain carbonic acid, which like the oxalic and mesoxalic acids is also capable of colligation with urea. No ureide of carbonic acid, indeed, has yet been obtained directly from uric acid, the active treatment which effects the complete oxidation of the uric acid effecting also a separation from one another of the resulting carbonic acid and urea, which, however, may be obtained in combination by other means. Allophanic acid, for instance, is a well known artificial mon-ureide of carbonic acid, but so far as I am aware no di-ureide of the acid has been hitherto produced by any process whatsoever.

The mon-ureide of mesoxalic acid, of which I have already spoken—namely, alloxan, is formed from mesoxalate of urea by an elimination of two atoms of water; but there is another ureide—namely, alloxanic acid, which differs from the original salt by the loss of only one atom of water. Similarly oxalic acid forms two mon-ureides—namely, parabanic acid or paraban analogous to alloxan, and oxaluric analogous to alloxanic acid. Carbonic acid, however, forms but a single ureide, which is produced by the elimination of only one atom of water, and accordingly belongs to the same series as the oxaluric and alloxanic acids, thus:—

Acids.	Ureides.
CH_2O_3 Carbonic	$C_2N_2H_4O_3$ Allophanic. „ „
$C_2H_2O_4$ Oxalic	$C_3N_2H_4O_4$ Oxaluric. $C_3N_2H_2O_3$ Paraban.
$C_3H_2O_5$ Mesoxalic	$C_4N_2H_4O_5$ Alloxanic. $C_4N_2H_2O_4$ Alloxan.

Similarly among the di-ureides, some are formed from their corresponding mon-ureides by an elimination of one atom, and others by an elimination of two atoms of water.

Now, mesoxalic acid is convertible by deoxidation or hydrogenation into tartronic acid, as I have already observed; and by pushing the deoxidation a stage further we obtain malonic acid, both of them capable of forming mon-ureides and di-ureides; and in a similar manner the oxalic and carbonic acids furnish a variety of similarly behaving deoxidation products. When we consider, then, the total number of carbonic or 1-carbon, of oxalic or 2-carbon, and of mesoxalic or 3-carbon, hydrogenised products; and that the majority of these products, like their original acids, are capable of forming mon-ureides by an elimination of one atom, and other mon-ureides by an elimination of two atoms of water; and, further, that many of these mon-ureides are capable of forming di-ureides by a further elimination of one atom and other di-ureides by a further elimination of two atoms of water, we are no longer surprised at the great number and variety of known compounds belonging to the uric acid group, and shall not be surprised at the discovery of very many more. The most important of those already known are included in the following table. It is divided perpendicularly into three columns of an-ureides, mon-ureides, and di-ureides; and perpendicularly into three layers of carbonic, oxalic, and mesoxalic products. The compounds connected by means of dotted lines differ in composition from one another by an excess or deficit of one atom of urea minus one atom of water; while those standing on the same level in the adjoining columns and unconnected by dotted lines, differ from one another by an excess or deficit of one atom of urea minus two atoms of water.

An-ureides.		Mon-ureides.		Di-ureides.	
CH_4O	Methylic	$C_2N_2H_6O$	Methyl-urea		
CH_2O_3	Carbonic	$C_2N_2H_4O_3$	Allophanic		
		$C_3N_2H_6O_2$	Acet-urea	— —	,,
		$C_3N_2H_6O_3$	Hydantoic	$C_4N_4H_6O_2$	Glycoluril
		— —	,,	$C_4N_4H_6O_3$	Allantoine
$C_2H_4O_2$	Acetic				
$C_2H_4O_3$	Glycolic	$C_3N_2H_4O_2$	Hydantoine	— —	,,
$C_2H_4O_4$	Glyoxylic	$C_3N_2H_4O_3$	Allanturic	$C_4N_4H_4O_2$	Mycomelic
		$C_3N_2H_4O_4$	Oxaluric	— —	,,
$C_2H_2O_3$	Glyoxalic				
$C_2H_2O_4$	Oxalic	$C_3N_2H_2O_3$	Parabanic	— —	,,
— —	,,	— —	,,	$C_5N_4H_4O$	Hypoxanthine
$C_3H_4O_4$	Malonic	$C_4N_2H_4O_3$	Barbituric	$C_5N_4H_4O_2$	Xanthine
$C_3H_4O_5$	Tartronic	$C_4N_2H_4O_4$	Dialuric	$C_5N_4H_4O_3$	Uric acid
— —	,,	$C_4N_2H_4O_5$	Alloxanic		
				$C_5N_4H_6O_4$	Pseudo-uric
$C_3H_2O_5$	Mesoxalic	$C_4N_2H_2O_4$	Alloxan		

Even this table, however, is far from being complete. Thus, I have introduced only one alcoholic urea as a type—namely, the methylic, excluding its homologues. I have also omitted uroxanic acid and several amidated and nitro-compounds, to which I shall presently refer. Moreover, between some of the consecutive mon-ureides shown in the table there exist certain diameric bodies formed by the union of the two consecutive mon-ureides with elimination of water. Thus, alliturie acid is a diamerone of hydantoine and allanturic acid, while leucoturic acid is a diamerone of allanturic acid and oxaluric or parabanic acid, thus:—

$$\begin{array}{ccccccc} \text{Allituric.} & & \text{Water.} & & \text{Hydantoine.} & & \text{Allanturic.} \\ C_6N_4H_6O_4 & + & H_2O & = & C_3N_2H_4O_2 & + & C_3N_2H_4O_3. \\ \text{Leucoturic.} & & \text{Water.} & & \text{Allanturic.} & & \text{Parabanic.} \\ C_6N_4H_4O_5 & + & H_2O & = & C_3N_2H_4O_3 & + & C_3N_2H_2O_3. \end{array}$$

In a precisely similar manner, among mesoxalic compounds we have hydurilic acid, a diamerone of barbituric acid and dialuric acid; while alloxantine is a diamerone of dialuric acid, and alloxanic acid or alloxan, thus:—

$$\begin{array}{ccccccc} \text{Hydurilic.} & & \text{Water.} & & \text{Barbituric.} & & \text{Dialuric.} \\ C_8N_4H_6O_6 & + & H_2O & = & C_4N_2H_4O_3 & + & C_4N_2H_4O_4. \\ \text{Alloxantine.} & & \text{Water.} & & \text{Dialuric.} & & \text{Alloxan.} \\ C_8N_4H_4O_7 & + & H_2O & = & C_4N_2H_4O_4 & + & C_4N_2H_2O_4. \end{array}$$

Of the many bodies above formulated, only a few call for any special remark. Hydantoic acid is also known as glycoluric acid, which is, perhaps, a better name for it. Again, the body here called allanturic acid is probably identical with the lantanuric acid of Pelouze, and also with difluan. Oxaluric acid is interesting from the alleged occurrence of its calcium salt in human urine, in the form of the dumb-bell crystals so often associated with the octahedral crystals of oxalate. That these dumb-bells may consist of oxalurate of calcium, as suggested by their discoverer, Golding Bird, is not indeed improbable; but the evidence that they really are so constituted is anything but satisfactory. The relations of allanturic and oxaluric acids to another uric acid product known as oxaluramide are obviously those of hydrogen and water to ammonia, as illustrated in the case of so many other compounds, thus:—

H.H	Hydrogen	$C_3N_2H_3HO_3$	Allanturic.
H.HO	Water	$C_3N_2H_3(HO)O_3$	Oxaluric.
$H.H_2N$	Ammonia	$C_3N_2H_3(H_2N)O_3$	Oxaluramide.

Allantoine, as shown by the fine specimen lent me by Messrs. Hopkins and Williams, is a beautiful crystalline body existing in the allantoic fluid of the fœtal and in the urine of the sucking calf. It has also been noticed by Frerichs and Städeler in the urine of two dogs, upon whose lungs they had been experimenting, and is very easily procurable from uric acid by oxidation with peroxide of lead. By deoxidation, it yields glycoluril (Rheineck).

Mycomelic acid may be obtained among other processes by treating uric acid with water under pressure, thus:—

$$\begin{array}{ccccc} \text{Uric acid.} & & \text{Mycomelic acid.} & & \text{Carbonic oxide.} \\ C_5N_4H_4O_3 & = & C_4N_4H_4O_2 & + & CO. \end{array}$$

As I have before observed, it stands to paraban in exactly the same relation that uric acid stands to alloxan. From the observations of Hlasiwetz it seems probable that some supposed urate of ammonia deposits occurring in urine really consist of mycomelic acid, which similarly evolves ammonia when treated with alkalies, and yields murexide when evaporated with nitric acid.

Of mesoxalic mon-ureides, alloxan and barbituric acid seem to be the most important. Alloxan, the first discovered product of the artificial oxidation of uric acid, has recently been recognised by Liebig as a pre-formed constituent of urine. By treatment with bromine, it yields bibromobarbituric acid, which is successively convertible by hydrogenation into the bromobarbituric and barbituric acids, which last serves as a sort of nucleus in the following series of compounds:—

Mesoxalic Mon-ureides.

$C_4N_2H_2(HO)_2O_3$	Alloxanic.
$C_4N_2H_2Br_2O_3$	Bibromobarbituric.
$C_4N_2H_4O_3$	*Barbituric.*
$C_4N_2H_3BrO_3$	Bromobarbituric.
$C_4N_2H_3(HO)O_3$	Dialuric.
$C_4N_2H_3(H_2N)O_3$	Uramile.
$C_4N_2H_3(H_2NSO_3)O_3$	Thionuric.
$C_4N_2H_3(NO)O_3$	Violuric.
$C_4N_2H_3(NO_2)O_3$	Dilituric.
$C_8N_4H_6(N_2O_3)O_6$	Violantine.

The last compound on the list—namely, violantine—seems to be not a diamerone or residuary, but a completed compound of the violuric and dilituric acids. It is observable that the mutual relationship of barbituric acid, dialuric acid, and uramile in this sub-group is strictly parallel to that of allanturic acid, oxaluric acid, and oxaluramide in the preceding one. Moreover, the malonic and barbituric acids are homologous with the oxalic and parabanic acids respectively, or the most oxidised of known 2-carbon uric acid products are homologically the representatives of the least oxidised 3-carbon products, thus—

$C_2H_2O_4$	Oxalic	$C_3N_2H_2O_3$	Parabanic
$C_3H_4O_4$	Malonic	$C_4N_2H_4O_3$	Barbituric,

although from another point of view they correspond more nearly with mesoxalic acid and alloxan, as I have already remarked.

The relationship subsisting between the three mesoxal-diureides, though long suspected from the similarity of their formulæ—hypoxanthine $C_5N_4H_4O$, xanthine $C_5N_4H_4O_2$, and uric acid $C_5N_4H_4O_3$—has but very recently received an experimental demonstration at the hands of Strecker and Rheineck. With the first of these bodies, or hypoxanthine, originally found by Scheerer in human and bovine splenic juices, the sarcine, subsequently discovered by Strecker in juice of flesh, and thought to be a distinct base, has since proved to be identical. From the results of Scheerer, Strecker, Gorup-Besanez, and others, it appears that hypoxanthine exists to a very appreciable extent in most glandular juices and in muscular tissue, particularly of the heart, while it has also been recognised in brain substance and in the blood and urine. It occurs as a white crystalline powder, insoluble in cold and sparingly soluble in hot water. By oxidation with nitric acid, it yields xanthine, and hence gives the characteristic nitric acid reaction of xanthine, which compound has also been detected in blood and in most animal juices. Under the name of xanthic oxide, it was discovered in 1819 by the elder Marcet in a variety of urinary calculus, which subsequent experience has proved to be very rare. It has been met with more frequently, indeed, though still very seldom, as an amorphous urinary deposit, and in one case recorded by Bence Jones it occurred in lozenge-shaped crystals. Its habitual presence, however, in small quantity as a dissolved constituent of urine seems now to be very well established. Xanthine, moreover, is not only known as a urinary, but also as an intestinal concretion, for Göbel has met with it as the chief constituent of certain oriental bezoar stones obtained from ruminating animals. I have already referred to Strecker's artificial production of xanthine by the oxidation of hypoxanthine or sarcine with nitric acid. Conversely, Strecker and Rheineck have very recently shown that uric acid by deoxidation with sodium-amalgam yields a mixture of xanthine and hypoxanthine, the latter in greatest proportion, so that the actual relationship of these three bodies is now placed beyond all question. Hitherto, hypoxanthine and xanthine, having been obtained in small quantities only, have not been subjected to any detailed examination. It can scarcely be doubted, however, that xanthine is a mon-ureide of barbituric and a di-ureide of malonic acid, in the same sense that uric acid is a mon-ureide of dialuric and a di-ureide of tartronic acid. We may hope, indeed, to have these relations very soon established by experiment; for even if it should not prove possible to prepare xanthine advantageously from uric acid, still the fact of its close relationship therewith would lead us to expect its more abundant existence than has been hitherto imagined; particularly, for instance, in the excreta of those animals whose normal mode of tissue waste results in the production of uric acid rather than urea. This expectation is strengthened by the extraction from that valuable dried excrement of sea-fowl known as guano of a feeble base called guanine, which bears to xanthine the same often-referred-to relation that ammonia bears to water, as shown in the following series of formulæ:—

$C_5N_4H_4O$. . . . Hypoxanthine.
$C_5N_4H_3(NO)O$ . . Xanthine.
$C_5N_4H_3(H_2N)O$ . . Guanine.
$C_5N_4H_2(HO)_2O$ . . Uric acid.

Just, in fact, as uric acid, and doubtless xanthine, yields by oxidation parabanic acid and urea, so does guanine yield by oxidation parabanic acid and amido-urea or guanidine,* thus:—

$$\overset{\text{Xanthine.}}{C_5N_4H_3(HO)O} + H_2O + O_3 = \overset{\text{Parabanic.}}{C_3N_2H_2O_3} + \overset{\text{Urea.}}{CN_2H_3(HO)} + CO_2 ?$$

$$\overset{\text{Guanine.}}{C_5N_4H_3(H_2N)O} + H_2O + O_3 = \overset{\text{Parabanic.}}{C_3N_2H_2O_3} + \overset{\text{Guanidine.}}{CN_2H_3(H_2N)} + CO_2.$$

Moreover, xanthine itself occurs in small quantity as a secondary product of the above oxidation of guanine, and probably might be obtained in larger quantity by treating guanine with nitrous acid, according to the general method adopted for converting amidated into hydrated bodies, thus:—

$$\overset{\text{Guanine.}}{C_5N_4H_3(H_2N)O} + \overset{\text{Nitrous.}}{(HO)NO} = \overset{\text{Xanthine.}}{C_5N_4H_3(HO)O} + N_2 + H_2O ?$$

That the guanine extracted from guano is a constituent of the birds' excrement as voided, and not a product of decomposition, is rendered probable by its occurrence under other circumstances. Thus it forms the chief portion of the excrement of the garden spider, has been recognised by Scheerer in the pancreas of the horse, and is occasionally met with in human urine.

We have now only left for consideration the pseudo-uric and uroxanic acids, which we may regard as terms in the following series:—

$$\begin{array}{rcll}
 & & C_5N_4H_4O_3 & \text{Uric.} \\
C_5N_4H_4O_3 + H_2O & = & C_5N_4H_6O_4 & \text{Pseudo-uric.} \\
C_5N_4H_4O_3 + 2H_2O & = & C_5N_4H_8O_5 & \text{Unknown.} \\
C_5N_4H_4O_3 + 3H_2O & = & C_5N_4H_{10}O_6 & \text{Uroxanic.} \\
C_5N_4H_4O_3 + 4H_2O & = & C_3H_4O_5 & \text{Tartronic} + 2CN_2H_4O \text{ Urea.}
\end{array}$$

Pseudo-uric acid is a recent discovery of Baeyer's. It has not actually been produced by the direct or indirect hydration of uric acid, but only by the combination of cyanic acid vapour with uramile. Just, in fact, as cyanic acid converts ammonia into anomalous cyanate of ammonia or urea, so does it convert the residue of ammonia contained in uramile into a residue of urea, so as to change the amido-monureide into a simple diureide, thus:—

$$\overset{\text{Uramile.}}{C_4N_2H_3(NH_2)O_3} + \overset{\text{Cyanic acid.}}{CNHO} = C_4N_2H_3(CN_2H_3O)O_3 = \overset{\text{Pseudo-uric.}}{C_4N_4H_6O_4}.$$

Pseudo-uric acid occurs as a white crystalline almost insoluble powder. Hitherto it has not proved dehydrateable into uric acid; but by dehydrogenisation in presence of water it behaves like uric acid, breaking up into alloxan and urea. The compound $C_5N_4H_8O_5$ is unknown, while uroxanic acid, $C_5N_4H_{10}O_6$, is known but very imperfectly. Unlike pseudo-uric acid, it really results from the absorption of water by uric acid, and is produced in the form of its potassium salt by boiling uric acid for a long time in solution of caustic potash. In the free state it occurs as a white, glistening, sparingly soluble powder. The absorption of a fourth atom of water by uric acid would probably lead, not to the formation of a new hydrate, but to the breaking up of the uric acid itself, possibly into tartronic and urea.

I have already referred to upwards of forty uric acid products, by no means all that are known, and I have indicated the existence of many more, as yet unknown, to fill up gaps in the different series. Now, when we reflect that in all probability most of these compounds, actual and problematical, do not stand alone, but are associated each with a more or less numerous set of isomers,—that is to say, of bodies having the same ultimate composition, but a different molecular arrangement—we scarcely venture to contemplate the almost overwhelming intricacy with which we are threatened. To us, as physicians, however, the subject is capable of assuming a simpler aspect. On any view of its constitution, hydrated uric acid differs in composition from two atoms of urea by the addition of three atoms of carbonic oxide, capable of oxidation into

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* By the oxidation of kreatine, which has been already described as a polymerone of glycolic acid, methylamine, and urea, its glycolic residue is converted into oxalic acid, while its methylamine and urea residues are left in combination to form methylamido-urea or methyl-uramine, a compound homologous with amido-urea or guanidine, thus:—

$CN_2H_3(HO)$ . . . . Urea.
$CN_2H_3(H_2N)$ . . . . Guanidine.
$CN_2H_3(CH_3HN)$ . . . Methyluramine.

Again, biuret $C_2N_3H_5O_2$, or $C_2N_2H_3(H_2N)O_2$, may be regarded as carbo-guanidinic acid, just as allophan $C_2N_2H_4O_3$ or $C_2N_2H_3(HO)O_2$ is regarded as carb-ureic acid.

carb-anhydride, and by that oxidation of generating a certain amount of heat, or its equivalent of motion :—

$$\underset{\text{Water.}}{H_2O} + \underset{\text{Uric acid.}}{C_5N_4H_4O_3} + \underset{\text{Oxygen.}}{O_3}$$

$$= \overset{\text{Carb-anhyd.}}{C_2O_2}(CN_2H_4O)_2 + O_3 = 3CO_2 + \overset{\text{Urea.}}{2CN_2H_4O}.$$

Hence, uric acid must be considered to result from the incomplete burning and using of nitrogenous tissue, whereby, instead of urea and carb-anhydride, urea and carbonic oxide are produced.

(To be continued.)

ACADEMY OF SCIENCES.

October 16.

M. Boussingault continued his memoir "*On the Respiration of Leaves.*" In the dark, leaves produce carbonic acid, which mixes with the surrounding atmosphere if the parenchyma is not thick and moist enough to retain it, as is the case with some plants. In former experiments the author determined the amount of oxygen produced in the light by a given extent of leaf under the influence of carbonic acid, and he now gives the amounts of carbonic acid emitted in the dark. It is seen from these experiments that for an equal extent of surface and in an equal space of time a leaf decomposes much more carbonic acid in the light than it forms in the dark. Eighteen experiments show that a square metre of leaf (oleander leaves were employed) will decompose in sunlight on the average 1·108 litres of carbonic acid per hour. Four experiments, however, showed that the same extent of leaf only formed 0·07 litre of carbonic acid in the dark. Thus leaves placed in carbonic acid in sunlight produce in the end a respirable atmosphere. But in darkness, they after a time lose the power of decomposing carbonic acid, and although they remain green and are to all appearance healthy, they are dead. Their death must be attributed to the absence of oxygen, the presence of which is indispensable to the elaboration of carbonic acid by slow combustion or respiration: the leaves, in fact, die asphyxiated. Nothing of the sort happens when leaves are secluded in a respirable atmosphere. In this they preserve their vitality, and the same leaf will alternately produce oxygen in the presence of carbonic acid and carbonic acid in the presence of oxygen.

M. J. Pelouze made a communication "*On Aventurine coloured with Chromium.*" The author gives the following proportions for the preparation of a glass comparable with Venetian aventurine :—

Sand	250	parts
Carbonate of soda . .	100	"
" lime . .	50	"
Bichromate of potash . .	40	"

The glass is full of exceedingly brilliant crystals, which reflect light like the diamond. It is extremely hard, and will scratch ordinary glass. This hardness adds greatly to its value for artistic purposes.

M. Pelouze presented another note "*On the Colouration of Glass by Selenium.*" Some months ago (see Chemical News, vol. xi., p. 250) the author showed that the yellow colour of ordinary glass was due to the presence of sulphur and sulphides coming from the reduction of sulphates present in some ingredients. He was now anxious to ascertain whether selenium would communicate any, and what, colour to glass. Experiment proved that it gives a beautiful orange tint, resembling that of some varieties of topaz, and zircon hyacinth. One per cent. of the metalloid will produce the effect. Thus the analogies between sulphur and selenium extend to their reaction on the earthy and alkaline silicates.

M. Scheurer-Kestner presented a note "*On the Theory of M. Dumas concerning the preparation of Soda by Le Blanc's Process.*" It was a reply to some observations made by M. Dumas after the reading of M. Kopp's memoir on the utilisation of soda waste. M. Dumas believes in the presence in soda waste of a compound of lime, and sulphide of calcium insoluble in cold water, and observed that the analyses of M. Kopp confirmed his views on the production of carbonate of soda by Le Blanc's process. M. Scheurer-Kestner states that his analyses prove that the residues do not contain an oxysulphide, but are made up of a mixture in variable proportions of oxide, carbonate, and sulphide of calcium, and he adds that it is impossible to represent the composition of the residues by any formula. The composition of the waste will necessarily vary according to the proportions of the chalk and sulphate used in the manufacture, and the relations between the sulphur and the calcium in the waste can always be calculated in advance. We have no space at present for more of this note.

[We may state here that we have received a letter from M. Kopp, who complains of our notice of his recent memoir as "a little too severe." We extremely regret that our esteemed correspondent should have so interpreted our remarks. In our next we shall publish his letter, which is, however, in places, difficult to decipher.]

M. Gal communicated a study of "*Some New Compounds Formed by Hydrocyanic Acid.*" One of these is the compound of hydriodic and hydrocyanic acid, a description of which, by M. Gautier, is given in another place. M. Gal also describes a compound with hydrobromic acid. This author's views of the constitution of these compounds differ somewhat from that of M. Gautier. He considers that they may be regarded as belonging to the type NX_5. Hydrocyanic acid belongs to the type NX_3, and the molecule of hydriodic acid comes in to complete the saturation of the nitrogen.

M. A. Semenoff presented a note "*On the Mono- and Dihydriodate of Allylene and Acetylene.*" Allylene combines almost instantaneously with hydriodic acid if the gas employed is perfectly pure and the acid very concentrated. The result is always dihydriodate of allylene, C_3H_6I, a heavy liquid with faint aromatic and bituminous odour, having the sp. gr. 2·4458 at 0°. This is isomeric with iodide of propylene. To prepare the monohydriodate the author digested the above-mentioned with an equivalent of potash in alcoholic solution, and distilled in a water bath. It is a very volatile, colourless liquid, of a strong but agreeable odour, boiling as 82°, and having the sp. gr. 1·8346 at 0°. It is isomeric with iodide of allyle.

Acetylene combines but slowly with hydriodic acid, and forms a mixture of mono- and dihydriodate. The monohydriodate was prepared in the same way as the corresponding compound of allylene. The monohydriodate of acetylene is a very volatile liquid, colourless, and of an agreeable odour, boiling at 62°. Analysis showed it to have the composition C_2H_3I. It is easily seen that this body is isomeric with monoiodated ethylene, but not identical, for the ethylene compound boils at 56°. Monohydriodate of allylene is probably isomeric, but not identical with monoiodated propylene.

NOTICES OF BOOKS.

Introduction to Modern Chemistry, Experimental and Theoretic. By A. W. Hofmann, F.R.S., LL.D., &c. London: Walton and Maberly. 1865.

This work is, beyond comparison, the most masterly and luminous exposition of the modern philosophical doctrines of chemistry that has hitherto fallen under our notice. Dealing with subjects essentially abstruse and intricate, and rendered still more difficult of treatment by the transitional state of opinion at present prevailing in the chemical world, the collaborating authors have succeeded in impressing upon their work a unity of conception, a cogency of demonstration, and a felicitous harmony of style, that fascinate the least attentive reader, and lead him on, with scarcely an effort, from the first to the last page of the book. In twelve discourses, of barely twenty pages each, is compressed a succinct yet perfect outline of the great philosophical edifice whose foundations were laid upwards of a century and a half ago by Homberg, extended in the course of the following century by Wenzel and Richter, and completed during the present century by the imperishable labours of Dalton, Wollaston, Gay-Lussac, Proust, Berzelius, Dulong and Petit, Mitscherlich, Laurent, Gerhardt, Dumas, Regnault, Hermann Kopp, Ampère, Liebig, Cannizzaro, Deville, Wurtz, Odling, Kékulé, Williamson, Frankland, Cahours, and (last not least) the author-in-chief of the work before us.

From the writings of these and other illustrious philosophers (for our enumeration is by no means exhaustive), from their experimental researches, their instructive controversies, their innumerable discoveries of fact, and generalisations of law, our authors have collected the leading principles which constitute, in their *ensemble*, the doctrine of the Modern Chemical School,—we had almost written, of the modern chemical Revolution.

This very expression is, indeed, employed in the preface of the work before us, to characterise the latter portion of the great Philosophical Movement in question:—

"No chemist will need to be reminded that, during the last quarter of a century, the science of chemistry has undergone a profound transformation; attended, during its accomplishment, by struggles so convulsive, as to represent what, in political parlance, would be appropriately termed a Revolution.

"Amidst continual accessions of fact, so rapid, so voluminous, and so heterogeneous, as almost to exceed the grasp of any single mind, chemical science has been in travail, so to speak, with new laws and principles of coordination, engendered, perhaps, partly by the sheer force of their own deeply-felt necessity, but partly also, and mainly due, to the powerful initiative impulsion of a few philosophical master minds.

"Based on the concurrent examination of the volumetric and ponderal combining-ratios of certain typical elements, and on the discovery, in their standard combinations, of a few well-marked structural types, these principles have introduced into the domain of chemistry the pregnant idea of Classification—the conception of a series of natural groups, resembling the genera of the biological sciences, and culminating in the establishment of an orderly system, where before there had seemed to be but a chaos of disconnected facts.

"Under the influence of these and certain other cognate ideas, new views have arisen as to the constitution and chemical properties of matter; a reformed chemical notation has thence of necessity ensued; and structural relations, previously unsuspected, have disclosed identity of parentage in compounds till then deemed utterly diverse.

"It appears to be wisely ordered, in scientific as in social affairs, that the innovating spirit which belongs to youth has its check and counterpoise in the conservative tendency essentially characteristic of age; so that, in the sharp collision of these rival forces, new principles, in any kind, find a sort of fiery ordeal interposed between their first enunciation and final acceptance; doubtless the appointed test of their soundness and vitality.

"Hence the domain of chemical philosophy has, for many years past, rather resembled a tumultuous battle-plain, than a field bestowed by nature for peaceful cultivation by mankind. The new ideas, springing up of necessity one by one, and not always free, at their first conception, from errors and inconsistencies, have been resisted, by the champions of the old chemical dogmas, as a gratuitous revolt against established authority. Controversy has naturally stimulated research, which, in its turn, has produced rapid modifications of theory; so that the aspect of chemistry has been in a state of incessant change. It is, indeed, only within the last few years that the new doctrines have acquired a logical consistency, and a consequent ascendancy throughout Europe, auguring at length for our long-agitated science a period of comparative calm."

We cannot better convey to our readers an idea of the scope and purport of this work than by the following further extracts from the preface. After referring to the "stormy controversial period" from which chemistry is but just emerging, as one during which the lecturer's teachings have often seemed "to resemble those dissolving scenes which, at a certain moment, present two landscapes, one in the act of melting away, while the other is unfolding itself to view," the writer proceeds to say,—

"It will be apparent from the foregoing remarks, that this work is of an essentially general and introductory character, designed to elucidate the leading principles of chemistry, and by no means presented as an encyclopædic compendium of its facts. So far, indeed, from seeking to multiply details, it has been the author's chief care to avoid them, and to enter upon descriptions of phenomena only in subordination to his main design."

Further on, the aim of the work is described as "essentially educational," and its method as, therefore, "experimental and illustrative, proceeding constantly from the concrete to the general; and extracting from a limited range of facts the largest amount of theoretic and general information which they can readily be made to yield."

For these reasons, the writer proceeds to observe,

"The elements are, in this work, studied in a new order, not gratuitously adopted, but determined by their aptitude, in his view, to lead up to the knowledge of general laws, in just and logical succession; and so also, while endeavouring to illustrate incidentally the leading topics of experimental chemistry, he has been mainly guided, in his selection of experiments, by their fitness for the elucidation of theoretical views. It is rather in accordance with these exigencies of his plan, than with reference to the relative importance of the subjects treated, that space has been meted out to these; some topics, in themselves of great moment, being dismissed with but a passing notice, while others, intrinsically less interesting, are elaborately discussed, on account of their bearing on questions of principle."

Referring to his lectures at the College of Chemistry as being embodied in this work, and constituting "its original framework," Dr. Hofmann observes that, in preparing the work for press, "such additional matter has been introduced as appeared desirable for the more complete elucidation of the great laws set forth."

Dr. Hofmann concludes his prefatory observations by a well-deserved tribute to his collaborator, Mr. F. O. Ward, "whose well-known powers of lucid composition, and habits of philosophical thought, will be traced in every chapter of this work. Attracted to the new chemical doctrines by their own intrinsic truth and beauty, Mr. F. O. Ward has willingly devoted himself for months past to the task of assisting in their exposition; and in the course of these labours, as was to be expected, he has originated many valuable conceptions for their clearer elucidation and development. One, indeed, of his friend's indications the author feels bound to mention here, as constituting a distinct and valuable contribution to the new chemical edifice. He alludes to the Quantivalential Equilibrium of the Nitroxygen Series, as demonstrated by Mr. Ward, and displayed in the striking symmetrical diagram introduced by him at p. 180."

We shall take an early opportunity of laying Mr. F. O. Ward's above-mentioned remarkable diagram, with its explanation, before our readers, and we shall also endeavour to make room, in future numbers, for one or two chapters as samples of this valuable work. The object of the present notice is merely to give our readers some general idea of its character and purpose. With this view, having first quoted its preface, we may now cite its eloquent conclusion—a rapid retrospective survey of the course, gracefully addressed by the lecturer to his students, as by a guide to travellers under his charge:—

"But now, fellow-travellers, we have arrived at a point where our progress together must be interrupted for a time. The plan of this brief introductory course is fulfilled; and its objects, so far as my limited powers permit their achievement, are attained. Before we part, however, let us, as wayfarers are wont, rest awhile on the gentle eminence we have attained, and take a retrospective survey of our route thus far. In other words—and to drop metaphor—let us endeavour, by a summary recapitulation, to fix in our memory some of the leading facts and principles which our experiments and reasonings, our inductions and deductions, have gradually unfolded to our view.

"As our point of departure, we selected, you remember, the familiar fluid, *water*; of which we learned the compound nature by an experiment, the simplest, perhaps, and the most striking, in the whole range of chemistry.

"This consisted in dropping on its surface a fragment of the alkali-metal, potassium, which, at the touch of water, took fire, at the same time liberating from it an inflammable gas, called hydrogen. This, upon examination, proved to be the lightest body known, and we accordingly adopted it as our unitary standard of volume-weight.

"This standard gas we proceeded to liberate by the same simple means from two other bodies less familiar than water, but very well known in the arts and manufactures—viz., muriatic acid and ammonia, both, in their pure state, gases at ordinary temperature and pressure.

"The further examination of these three sources of hydrogen revealed to us the existence of three gaseous bodies,—chlorine, oxygen, and nitrogen, as being respectively associated with hydrogen, in muriatic acid, water, and ammonia.

"The study of chlorine, oxygen, and nitrogen showed us, in the first, one of the most active of chemical agents; in the second, the typical supporter of combustion; in the third, one of the most inert bodies known.

"By the *analytic* method, applied to decompose the three hydrogen compounds of these gases, and by the *synthetic* method, employed so far as available, to reconstruct them, we learned the proportions, as well by volume as by weight, in which chlorine, oxygen, and nitrogen respectively combine with hydrogen, in muriatic acid, water-gas, and ammonia.

"With one unit-volume each of chlorine, oxygen, and nitrogen, weighing respectively 35·5, 16, and 14, were found hydrogen combining in the unit-volume and weight-ratio of 1 for the first-named body, 2 for the second, and 3 for the third.

"Notwithstanding this inequality in the number of unit-volumes of the gaseous constituents of these compounds, we found the volumes of the gaseous products to be exactly equal; measuring in all three cases alike 2 unit-volumes. This curious circumstance proved to us that condensation increases, in these typical cases, *pari passu*, with the number of hydrogen-volumes engaged.

"We thus experimentally established three well-defined models of chemical structure, displayed in the combination of 3 typical elements with the standard element, hydrogen.

"To these types, both of elementary and compound bodies, a fourth in each kind was soon afterwards added; *carbon* presenting itself to our notice as the type of the *non-volatile* elements; while the richest in hydrogen of its hydrogen compounds—viz., *marsh-gas*—contributed its final term to our series of structural models. We had found the three gaseous typical elements successively engaging, within equal product-volumes (double the unit-volume in each case), 1, 2, and 3 volumes of hydrogen; and now, in the like product-volume of marsh-gas, we found carbon engaging 4 volumes of hydrogen.

"Hence the sort of *disjunctive conjunction* by which we annexed to our typical series of compounds this singular body, marsh-gas: alien with regard to the non-volatile character of its typical constituent, carbon; cognate in respect of its ponderal, volumetric, and condensational relations with its standard constituent, hydrogen.

"To the establishment of the typical elements and their typical hydrogen compounds succeeded, naturally, the study of the congeners in each kind; and we were thus led to make acquaintance with bromine and iodine as analogues of chlorine, and with their respective hydrogen compounds as analogues of hydrochloric acid. With oxygen, and its hydrogen compound, water, we associated, in like manner, sulphur and selenium, and their respective hydrogen compounds cast in the structural mould of water-gas. With nitrogen and its hydrogen compound, ammonia, we connected phosphorus and arsenic, and their ammonia-like combinations with hydrogen. With carbon, lastly, and its hydrogen compound, marsh-gas, we conjoined, in like manner, silicon and its hydrogen compound, formed on the marsh-gas model.

"In these four groups of typical elements and compounds, we recognised the germ of a grand conception,—that of a natural classification of chemical bodies into genera and species, each distinguished by well-marked characteristics, not excluding individual varieties, but grouping them in subordination to collective laws.

"In the course of these experimental demonstrations, we became acquainted with the meaning of the term *chemistry*, and we obtained our first notions concerning the nature of chemical phenomena. We learned, for example, the characters of elementary as distinguished from compound bodies; of chemical combination as contradistinguished from mere mechanical mixture; of combining proportions, volumetric and ponderal; and of the immutability by which they are characterised.

"While thus gradually learning the general principles and laws of chemistry, we also became familiarised, as we proceeded, with the aspect and uses of chemical apparatus, and with the manipulations necessary for their dexterous employment. We gained experience more particularly of the methods in use for generating, collecting, transferring, measuring, desiccating, testing, and weighing gaseous bodies, and for ascertaining the influence of varying temperature and pressure on their bulk and density.

"Our analytic and synthetic operations obliged us to employ, by turns, the powerful agencies of electricity, light, heat, and the specific power we termed *chemism*, in order to bring about desired reactions; and these we often found to be attended with remarkable physical perturbations, as, for instance, with the sudden development of light and heat, and often with more or less violent explosion. The means of generating and applying the (so-called) imponderable forces, and of controlling their effects, when excessive or dangerous, were thus brought prominently, though cursorily, under our notice.

"Upon the individual characters of the elements and compounds thus submitted to investigation we did not dwell at length; nor, indeed, did we enlarge even upon the general laws with which we met in our course: it was our care to note only such particulars as came within the scope, and promoted the purposes, of our immediate inquiry.

"Doubtless, each subject which we thus touched by the way opened a tempting path to our curiosity; as the climber, whose appointed aim is the top of the tree, is tempted by the fruit-laden branches he passes in his ascent.

"But though we gladly accepted the incidental information which our experiments naturally threw in our way, we forbore from prolonged digressions, and persisted steadily in the straight course of our inquiry.

"This led us next to the study of the curious and important bodies constituting the nitroxygen series—a study in which we broke entirely new ground, quitting the consideration of the typical hydrogen compounds, each of which only exemplifies combination in a single fixed ratio, and advancing to the examination of a new and pregnant law of chemistry, that of combination in *multiple proportions*.

"As our induction thus extended itself and our facts began to accumulate, we felt the want of some instrument of record, less periphrastic than ordinary parlance, to epitomise concisely, and to bring graphically and simultaneously under the eye, trains of phenomena which it would else be difficult to grasp and comprehend, firstly, in their mutual relations to each other, and secondly, in their common dependence on general laws.

"We were thus induced to represent our gas volumes by squares, *lettered* with the initials of the bodies depicted, *figured* with their relative volume weights, and forming the germ of a symbolic nomenclature and notation which, in the further stages of our progress, we were enabled at once to enrich and to simplify by incorporating in it our newly-acquired facts, and eliminating from it forms too cumbersome for practical use, though invaluable as aids to chemical education.

"That our proportional numbers, abstract at first, might acquire a concrete significance, we had to make choice of some system of weight and measure in terms of whose unitary standards to express those otherwise vague determinations.

"This led us to study the admirable metrical system of the French, which supplied us with our standard of capacity, the *litre*, and of weight, the *gramme*; at the same teaching us, by means of Greek and Latin prefixes, to express their multiplication and division in decimal progression.

"The weight of the standard volume (1 litre) of our standard element (hydrogen), expressed in terms of our new ponderal unit (1 gramme), gave us the invaluable co-efficient 0·0896 gramme, which, as you remember, we called our 'barley-corn weight,' or *crith*, by means whereof, as a multiplier, we convert the figures representing the mere abstract specific gravities of the various gases and vapours into expressions of their actual or concrete litre-weights.

"The concrete values with which our symbolic expressions thus became clothed increased the powers of our system of notation, both as a language for recording phenomena and as an instrument to assist in their investigation, experimental and theoretic.

"Thus armed, we ventured upon speculative ground; we sought the interpretation of the phenomena we had as yet but observed; we endeavoured to explain, by a rational hypothesis, the remarkable proportionality, ponderal and volumetric, of chemical reactions; and, with this view, we entered on the inquiry, What *is* matter? Of what parts is it composed? How are these affected by the solid, fluid, and gaseous conditions? How are their interspaces filled? And what, in particular, is the corpuscular construction of a gas?

"In studying these questions we were led to admit the threefold divisibility, molar, molecular, and atomic, of material bodies, and to refrain from asserting their *infinite* divisibility. The elasticity of gases are attributed to a force connected, in some unknown way, with *heat;* whose specific relations to different bodies, and so-called *latency* therein, enabled us to understand certain, else inexplicable, properties of gases, and to conceive these bodies as built up of molecules, or atom-clusters, of which all gases are assumed to contain equal numbers in equal volumes.

"In the light of these conceptions our symbolic language took on a new significance. Besides representing volumes and volume-weights, our squares became pictures, forms of molecules, and atoms, whose movements of decomposition and reconstruction we were thus, in imagination, enabled to follow.

"We thus become familiar with the diatomic structure of the typical elementary molecules, with the monatomic and polyatomic structure of certain other molecules, and with the molecule-forming and atom-fixing powers of the elementary atoms, the former of which powers we found to be in the ratio of their atom-weights, while the latter we identified with their atom-freeing and atom-replacing powers, all of which we included in the term quantivalence. These studies led us naturally to touch on and illustrate the principles of quantivalential coefficients.

"Having learned this much from the study of binary compounds, we passed on to consider compounds of a higher order—ternary, quaternary, &c., and the several modes of their genesis from binary compounds, as, for instance, sometimes by molecular, sometimes by atomic inception, each sometimes attended, and sometimes not, by substitutional displacement of atoms from the parent compound.

"Examples of ternary compounds generated in each of these modes were supplied to us in the lecture of to-day by the four typical groups with whose study we commenced our course. In our rapid review of these compounds, we noted their usually closely-packed product-volumes, or high vapour-densities; their frequent tendency to dissociation; their habitual retention of the structural type of their parent compounds; and the principles of their progressive or serial development. The last gas, which, in becoming methylic alcohol by inception of oxygen, threw open the gate of a new field of inquiry, and brought our present journey to its term.

"In this rapid retrospective survey, I have not attempted to be enclycopædic; my wish has merely been, at parting, to recal the more important of the many deeply-interesting topics which flowed upon us in succession, as out of a living source, from the pregnant conception of the molecular and atomic construction of matter.

"It can now, indeed, be no matter of surprise to you that we devoted so much time to the consideration of molecules and atoms, and dwelt at so much length upon the methods in use for determining the molecular and atomic weights of the elements. These are the foundations of chemical knowledge; and the table in which they are given, together with their symbols and coefficients of quantivalence, though, as we are aware, some of the figures are still doubtful, deserve our close and frequent study. The more of its figures we can bear in mind, the more accurate and ready will our knowledge be, whether for theoretic or practical applications.

"But I must not linger on these themes, nor, to defer unwelcome separation, trespass still further beyond limits already overpast. If, in conclusion, I resume my metaphor, and bid you adieu as fellow-travellers, it is because I deeply feel how much there is in the present transitional condition of chemistry to justify such an expression, and am almost painfully conscious how narrow is the explored domain through which the teacher can be your guide in comparison with those vast regions of truth as yet unknown, in which we are all fellow-students together.

"And thus, a learner myself, day by day, I can the better appreciate your constant and sympathetic attention to my lessons, and am encouraged the more earnestly to hope that the facts and principles which, in these few meetings, we have passed in review together will not merely afford us some present insight into the new doctrines now so deeply and, let me add, so wholesomely agitating the chemical world, but will also serve as a firm basis on which, in future conferences, we may build up, stone by stone, the vast superstructure of the chemical edifice."

Nothing can be imagined more admirable in tone and taste than this philosophical farewell, in which, with the modesty which true learning inspires, we see the teacher humbly identifying himself with his pupils. We are, indeed, all of us, from the most eminent to the most obscure, "learners, day by day,"—"fellow-students" in the great amphitheatre of Nature,—"fellow-travellers" through the vast regions of truth unexplored! Happy if it be permitted to us to bring, each but a single stone of the grand edifice which it has devolved on our generation to build up!

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

2137. R. A. Brooman, Fleet Street, London, "Improvements in the manufacture of cast steel and cast iron, and the manufacture of a mixed metal." A communication from E. Martin and P. E. Martin, Paris.—Petition recorded August 18, 1865.

2357. L. G. Sourzac and L. Bombail, Bordeaux, Gironde, France, "Improved means for rendering leather more durable and flexible."—Sept. 15, 1865.

2461. T. F. Caslim, Sheffield, and J. F. Allender, Parkgate, near Sheffield, "Improvements in the manufacture of iron and steel, and of furnaces and machinery for purifying, puddling, or heating, the same."—Sept. 26, 1865.

2483. R. Reece, Llandilo, Carmarthenshire, "Improvements in obtaining and applying sulphurous acid and in apparatus used therein."—Sept. 28, 1865.

2523. C. D. Abel, Southampton Buildings, Chancery Lane, "Improvements in the mode of treating the roots of the lucerne plant for the purpose of manufacturing paper, pasteboard, fabrics, and ropes therefrom." A communication from J. P. Caminade, Rue d'Hilliers Orleans, Loiret, France.—Oct. 2, 1865.

2555. W. R. Barker, New Bond Street, "Improvements in apparatus for administering injections and douches to the human body."—Oct. 5, 1865.

Notices to Proceed.

1469. P. Young, Manchester, "Improvements in the construction of furnaces."—Petition recorded May 29, 1865.

1884. G. Nimmo, Jersey, New Jersey, U.S.A., "Improvements in the manufacture of pots and crucibles wherein metals and other materials may be heated or melted."—July 19, 1865.

2008. J. W. Perkins, Norfolk-street, Strand, "Improvements in the treatment of hydrocarbon or paraffine oils."—August 3, 1865.

2071. M. H. Blanchard, Blackfriars Road, Surrey, "Improvements in the manufacture of terra-cotta or vitreous stone."—August 10, 1865.

2163. J. G. Avery, Regent Street, "A new composition suitable for use as paint and protective coating."—A communication from W. Potter, Saratoga, U.S.A.—August 22, 1865.

1547. D. Barker, Ceylon Street, Battersea Park, "Improvements in the manufacture of artificial fuel."—Petition recorded June 6, 1865.

1590. R. A. Brooman, Fleet Street, London, "Improvements in furnaces." A communication from F. Durand, Paris.—June 12, 1865.

1602. T. Routledge, Ford, near Sunderland, and W. H. Richardson, Springwell, Jarrow-on-Tyne, "Improvements in the manufacture of paper and paper stock, and in the utilisation of certain waste products resulting therefrom."—June 13, 1865.

1809. J. Baggs, Chancery Lane, "Improvements in the production of artificial light, and in the apparatus connected therewith."—July 8, 1865.

2100. J. T. Lockey, Sutton, Lancashire, "Improvements in and connected with the manufacture of copper."—Aug. 16, 1865.

2440. G. E. Rolland and E. L. Rolland, Paris, "An improved liquid composition for cleansing, scouring, and bleaching textile, animal, mineral, and vegetable substances."—Sept. 23, 1865.

CORRESPONDENCE.

Water from a Maniacal Point of View.

To the Editor of the Chemical News.

Sir,—Although the madmen here who have got me and a number of other perfectly sane individuals under their charge will not allow me the use of chemicals and apparatus, my brain works as actively and as clearly as if I had the Royal Institution laboratory at my disposal. I have just made a most important discovery, which I lose no time in communicating to you.

I have discovered that water is a member of the already large tribe of ammonias. If we take the compound atom

$$N'''\left\{\begin{matrix}H'\\H'\\H'\end{matrix}\right.$$

as a typical basis, nothing is easier than to replace the triatomic atom N''' by the monatomic atom H' and the diatomic atom O'', we then replace one of the H's by the monatomic radicle HO, and the thing is done. Water must, therefore, henceforth be formulated thus:—

$$\begin{matrix}H'\\O''\end{matrix}\left\{\begin{matrix}HO'\\H'\\H'\end{matrix}\right.$$

and must be called *dihydrohydorylhydroxamine*. Hydrate of potash will be—

$$\begin{matrix}H'\\O''\end{matrix}\left\{\begin{matrix}HO'\\K'\\K'\end{matrix}\right.$$

dipotasshydorylhydroxamine. Of course the H' and O'' on the left side of the bracket exist in a state of combined separation, or separate combination, which allows them to perform triatomic functions.

I am now hard at work on marsh-gas, which, I have no doubt, I shall also shortly be able to prove to be an ammonia.

Yours ammoniamaniacally,
N. H. Three.

Hanwell.

Detection of Sugar in Beer.

To the Editor of the Chemical News.

Sir,—The statement of the Excise chemist, that sugar cannot, in the present state of chemical science, be detected as an adulteration in beer, induces me to ask whether the fermentation or oxide of copper test is inapplicable in the case of the adulteration mentioned. I can hardly suppose that the experiments have not been made, and therefore I should be glad to have your opinion before I make any myself.

I am, &c.
Tyro Chemicus.

[It is one thing to prove the presence of sugar and another to prove it an adulteration.—Ed. *C. N.*]

ANSWERS TO CORRESPONDENTS.

Alpha.—Put more oxalic acid and a little gum.

Dr. Muspratt.—Received. Shall receive attention.

C. B.—If you have any difficulty in getting the book, it can be sent from our office.

J. G. B.—The matter is too important for us to assume the responsibility of advising upon.

Tyne.—What examinations? You had better inquire of the Registrar at Burlington House.

J. C.—We have heard nothing about the book of late, and the author, we understand, has gone abroad.

Chemicus would feel greatly obliged to the readers of the Chemical News if any of them could give him the names of any works on the manufacture of pigments and colours, in English, French, or German.

Books Received.—"On Epidemic Cholera and Diarrhœa: their Prevention and Treatment by Sulphur," by John Grove, M.D., &c. (Third Edition.)

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Experiments with the Ammonium Amalgam, by CHARLES M. WETHERILL, *Ph.D.*, *M.D.*

The existence of the hypothetical radical NH_4 depends less upon the characteristics of its so-called amalgam than upon the parallelism of its salts with those of the alkalies. If, from these analogies, we accept the metallic nature of ammonium, it will be difficult to avoid assigning a similar character to the radicals of all of the organic bases; and especially to those which, like the compound ammonias, have an alkaline reaction and possess physical and chemical properties so like ammonia.

If such be the inference, we must admit numerous compound metals, which exist only in certain states of combination of their elements. The assumption of the elementary nature of a metal is destroyed and the ideas of the alchemists are revived; for if NH_4 be a metal and NH_3 be not one, why may not other metals, esteemed elements, be also compounds?

In examining the so-called ammonium amalgam one is interested at the great resemblance which it bears to tho amalgams proper in its physical properties. The mercury has lost its fluidity or mobility, and, at the same time, its relations of cohesion and adhesion are very sensibly altered. It no longer coheres powerfully, but adheres to, or wets, platinum iron and other metals, like the potassium or sodium amalgam. When left to itself, the swollen mass shrinks, and gradually resolves itself into $NH_3(NH_4O)H$ and Hg, because (as is usually explained) NH_4 has a great tendency to fall apart into NH_3 and H. This explanation might be satisfactory when applied to the difficulty of isolating NH_4, as from any of its salts; but is not so in the case before us.

If ammonium falls apart thus readily in the presence of mercury, why does it combine with it at all to be decomposed in the very act of union? If it be said that in NH_4Hg the NH_4 has so great a capacity for oxidation that it at once decomposes water, with the formation of NH_4O and H; still why should NH_4 unite with the mercury, which is not as near to it as, or at least no nearer than, the water? In reflecting upon the phenomenon, I conceived the idea that there is really no amalgam of ammonium formed; but, in the reaction, the sodium decomposes the water, evolving hydrogen, and forming caustic soda, which in its turn sets free ammonia from the chloride, the mercury being also liberated. Thus

$$NH_4Cl + HO + HGNa = NH_4O + H + NaCl + Hg.$$

At the same time the molecules of the mass are altered in their capacity for cohesion by catalysis, polarity of atoms or some unknown cause, so that the bubbles of gas are retained, and swelling takes place.

Without the assumption of an unknown cause, the swelling may be accounted for by admitting that the evolution of gas brings portions of the sodium amalgam out of contact with the solution, and the mass thus remains pasty enough to retain the gas bubbles of hydrogen and ammonia for a while. The swelling may subside by reason of the final oxidation of this residual sodium amalgam.

By the kindness of Professor Henry, the opportunities of the laboratory of the Smithsonian Institution were afforded me in the winter of 1863-4, to perform the following experiments upon this subject.

The ammonium amalgams were obtained by the agency of the sodium amalgam, which was itself prepared by warming distilled mercury and projecting sodium therein. By varying the proportion of mercury, the sodium amalgam was obtained either quite fluid, pasty, in acicular crystals or quite hard. The ammonium amalgam was prepared from all of these alloys; but when a hard amalgam was used in the experiment, the ammonium amalgam formed upon the surface of the lump and proceeded gradually to the inside, and the swelling was not so great at the close of the reaction. The more fluid the sodium amalgam was, the more readily did the swelling take place.

Ex. 1. Sodium amalgam projected into dilute solutions of sulphuric or hydrochloric acids, or into an aqueous solution of potassa, decomposes water, but not violently. The mercury does not swell, but this phenomenon takes place immediately if a little solution of sal-ammoniac be added. It is not, therefore, merely hydrogen (itself a hypothetical metal), in the nascent state which occasions the swelling.

Ex. 2. Sodium amalgam in a solution of ammonia decomposes water without swelling; but this phenomenon ensues immediately if a drop of sulphuric or hydrochloric acid be added. Hence, hydrogen in the nascent state and ammonia in the condition of stable equilibrium do not produce the swelling. To effect this the ammonia itself must also be nascent.

Ex. 3. When the ammonium amalgam is made in a test tube containing a thermometer, a rise of temperature of from 2° to 3° C. is indicated during the swelling. The temperature falls at the completion of the swelling. If the turgidity subsides by reason of the great affinity of NH_4 for the oxygen of the water, decomposing the latter with the evolution of hydrogen, an elevation of temperature ought to be maintained until the NH_4 has become converted into NH_4O.

Ex. 4. If a test tube be filled with a solution of sal-ammoniac, inverted in a capsule containing the same salt, and a piece of sodium amalgam be introduced under the test tube, the ammonium amalgam is at once generated, with the constant evolution of hydrogen gas; the porous amalgam floats up to the surface of the liquid, and, subsiding after a while, gradually returns to mercury. From the time that the swelling is at its maximum until the mercury is restored to its pristine condition, there is but trifling increase of the volume of the gas, and this increase appears to be due to the minute particles of sodium amalgam which have been brought out of contact with the sal-ammoniac by reason of the turgescence. None of the gas in the test tube is absorbable by water; it is all hydrogen, and the sal-ammoniac remaining reacts strongly alkaline. The same phenomenon takes place when the amalgam is formed in a solution of sal-ammoniac in a capsule under a layer of naphtha. The presence of air, therefore, has no part in the subsidence of the swelled mass.

Ex. 5. When the amalgam, having again sunk to the bottom of the capsule in the last experiment, is pressed with the finger against the vessel, under the naphtha, it has at first a pasty or smeary nature; but, apparently by the expression of hydrogen gas from its pores, it is very quickly restored to the ordinary condition of mercury.

Ex. 6. When the ammonium amalgam is squeezed through a piece of muslin, it is immediately, and without change of temperature, or other evidence of affinity, resolved into mercury.

Ex. 7. If a drop of sal-ammoniac solution be placed upon a plate of glass, a lump of soft sodium amalgam be added, and another plate of glass be pressed upon the whole, the ammonium amalgam formed cannot swell, but expands laterally, assuming a reticular appearance by reason of the many gas bubbles which in fact thus become perceptible.

If a lump of ammonium amalgam, already in the swollen condition, be pressed between two plates of glass, it is spread out into a thin perforated film resembling lace.

Ex. 8. If a piece of spongy platinum be heated and stirred into smelted sodium amalgam, the latter fills the pores of the platinum sponge, and coats it uniformly. A piece of this compound in contact with a solution of sal-ammoniac, evolves hydrogen and ammonia, but does not swell; nor does a globule of liquid mercury, expressed from the mass, exhibit any of the characters of the ammonium amalgam.

Ex. 9. A piece of ammonium amalgam was wiped gently with filter paper and placed in naphtha. After a little while (to permit any adherent water to be decomposed) a test tube full of naphtha was inverted over it, the evolution of hydrogen gas continued as the amalgam shrank, and when, after the lapse of an hour, the mercury was restored to its usual condition, a bubble of gas, equal in volume to the globule of mercury, was collected.

Ex. 10. If a drop of sodium amalgam be heated upon a glass plate, then touched with a drop of sal-ammoniac solution, it at once swells to the full size of an ammonium amalgam which would have required several minutes if the reaction had taken place in the cold.

Ex. 11. The sodium amalgam decomposes cold water with comparative slowness; in boiling water a rapid evolution of gas takes place, although some time is required to fully oxidise the sodium. Boiling solution of aqua ammonia acts like boiling water. In none of these cases does any swelling take place, but this phenomenon is manifested immediately if to the boiling aqua ammonia a few drops of carbonate of ammonia be added.

Ex. 12. The ammonium amalgam is formed with apparently equal facility, employing the solutions of the following ammoniacal salts:—Chloride, oxalate, sulphate, and bi-sulphate; the characteristics of the amalgam thus formed being alike. The reaction with bisulphate of ammonia is instructive, showing the formation of the amalgam in the presence of an acid which facilitates the decomposition of water by certain metals. If a piece of reddened litmus paper be saturated with solution of bisulphate of ammonia, and a piece of sodium amalgam be dropped thereupon, the formation of the ammonium amalgam takes place as usual, and the evolution of the ammonia neutralises the acid, producing an alkaline reaction upon the paper under the mass.

Ex. 13. The ammonium amalgam cannot be formed with solution of nitrate of ammonia. With this reagent a very rapid evolution of gas takes place, and a globule of mercury remains. In this reaction there are no indications of hyponitrous or nitrous acids, and a drop of sulphide of ammonium added to the resulting liquid produces no colouration, except in a film upon the globule of mercury. If a drop of fluid sodium amalgam be projected into a drop of solution of sal-ammoniac upon a glass plate, the ammonium amalgam is formed rapidly; but a few drops of solution of nitrate of ammonia poured upon the swelled mass reduce it instantly, and without the evolutions of nitrous fumes, to the condition of ordinary mercury.

Ex. 14. By the kindness of M. Carey Lea, Esq., who furnished me with some of the salt, I have acted upon the sodium amalgam with solution of oxalate of methylamine. A slight turgescence is exhibited in this reaction, but not nearly to so great an extent as with oxalate of ammonia. The globule of methylamine amalgam pressed between glass plates manifests a reticulated appearance from gas bubbles, but to a less degree than in the case of ammonia salts. Hydrogen and methylamine are evolved.

Ex. 15. With the battery.—The ammonium amalgam was formed by the battery, using different ammonia salts in contact with mercury at the negative pole.

The general characteristics of the amalgam thus obtained were the same as when sodium was employed.

With a Smee battery of six pairs, of which each zinc plate measured 3 × 5 inches, the amalgam was obtained in small quantities; but ten of Bunsen's elements were required to obtain sufficient to study its properties.

By the electrolysis of a solution of sal-ammoniac contained in a U-tube, which was furnished with a porous diaphragm of filter paper, decomposition took place rapidly with either of the batteries; hydrogen and ammonia appearing at the negative pole, and nitrogen, chlorine, and hydrochloric acid at the positive pole. No formation of chloride of nitrogen was detected in the reaction.

The amalgam did not form with mercury in the negative branch of the U, the decomposition then being the same as without the metal.

The electrolysis of carbonate of ammonia yielded similar results, carbonic acid being evolved.

With solution of nitrate of ammonia in a U tube, hydrogen and ammonia appeared at the negative pole, and nitric acid and oxygen at the positive electrode. A small quantity of the gases collected at the positive pole were absorbed by water. If a globule of mercury be placed in a cup-like depression in a moistened lump of sal ammoniac or carbonate of ammonia, and be connected with the negative pole, the circuit being completed through the salt, the ammonium amalgam is formed while the current is passing.

If a piece of filter paper be placed upon a glass plate, and be moistened with a solution of carbonate of ammonia containing lumps of the salt, and if upon the paper a globule of mercury be deposited, the amalgam is beautifully manifested when the current of a ten-cell Bunsen battery is passing through the mercury and paper, the metal being in contact with the negative pole. The amalgam swells out in a dendritic form, tending towards the positive pole and maintaining its position while the current lasts. Upon breaking the connexion the swelled mass shrinks gradually. At all times, until restored to the condition of mercury, the amalgam exhibits numerous and minute gas bubbles when pressed between glass plates.

If, during the passage of the current, a glass plate be pressed upon the amalgam, it is flattened into a thin plate or film. By this means the swelling is prevented, and the ammonium amalgam is not formed. This result appears to be conclusive as to the non-existence of the ammonium amalgam, for, if it exist, it should be maintained in a film as well as in a globule as long as the current is passing.

The so-called ammonium amalgam could not be formed by the electrolysis of nitrate of ammonia, and a few drops of a solution of this salt causes the swelling to subside in ammonium amalgam already formed by the action of the battery upon sal-ammoniac, or carbonate of ammonia, in contact with mercury.

If spongy platinum, imbued with mercury, be placed in contact with the negative pole of the battery, and the current be passed through either a solution of sal-ammoniac, or one of carbonate of ammonia to the positive pole, no swelling takes place, even though a large globule of mercury adhere to the sponge; but violent ebullition of gas is manifested.

This is a very instructive experiment. The sponge of platinum cannot act by reason of fine pores, for they are all filled with mercury. The prevention of the amalgam formation must lie in the nature of the platinum itself; itself; it is a catalytic or contact action.

From these experiments it would seem that—

1. The so-called ammonium amalgam is not an alloy of mercury and ammonium.
2. The swelling of the mass in the phenomenon is due to the retention of gas bubbles; and,
3. The coherence of the gases and liquids concerned is changed from a normal condition, exhibiting phenomena which may be classed with those of catalysis.

[We remember, about fifteen years ago, witnessing some most interesting experiments by a talented young chemist, Mr. Scarlett, on the subject of the ammonium amalgam. Mr. Scarlett, who was then a student at the Royal College of Chemistry, had not only discovered a way of preserving ammonium amalgam by submerging it under castor-oil, in which it appeared quite permanent; but, we believe, he had succeeded in re-forming the amalgam, without the intervention of sodium, by the direct combination of its constituents in sealed tubes. Many Fellows of the Chemical Society will doubtless recollect the interest with which Mr. Scarlett's ammonium amalgam, in pint bottles, was examined, at the close of one of the evening meetings in Cavendish Square. We believe Mr. Scarlett died soon after. Can any of our readers inform us if he left any record of these valuable experiments?—Ed. C. N.]

Analysis of Natural Phosphates, by R. Warington, *jun.*[*]

Phosphoric acid forms insoluble compounds with nearly all bases except alkalies. When occurring combined with an alkali, it is determined by the chemist without difficulty; in our manures, however, it is found united with lime, oxide of iron, alumina, and magnesia, and it is when in this form of combination that its estimation has given chemists so much trouble. More attention and ingenuity have perhaps been called forth by this problem than have been bestowed upon any other portion of chemical analysis; the result has been the publication of a great number of excellent processes. The subject is a large one; we shall mention those methods only which are applicable to agricultural phosphates.

I. Estimation as Phosphate of Lime.—Attention is naturally called first to the old, and still very common method of precipitation by ammonia; advantage is taken of the insolubility of phosphate of lime; ammonia is added to the acid solution of the phosphate; and the precipitated phosphate of lime collected and weighed. In cases where phosphate of lime occurs associated with only alkaline salts, as in Peruvian guano, this plan leaves little to be desired; the insolubility of phosphate of lime is, however, not quite equal to the requirements of analysis. In applying this method to bone-ash, the results obtained are frequently too high; the precipitated phosphate containing an excess of lime (mechanically held) derived from the carbonate of lime present in bones. This error is to a great extent removed by redissolving the phosphate after it has been washed, and then reprecipitating it. The determinations thus made can never be very exact; they are sufficiently so, however, for some commercial purposes, and the method has the advantage of simplicity and speed.

This method is wholly unfit for the analysis of coprolites, which contain a much larger proportion of carbonate of lime than bone—namely, about 1 part of carbonate to 4 of phosphate; while in bones the proportion is 1 to 15. Besides, coprolites generally contain a small quantity of fluoride of calcium—a salt insoluble in water, and, therefore, precipitated with the phosphate of lime. The results obtained are, therefore, invariably too high. Thousands of tons of coprolites are, nevertheless, yearly purchased on the strength of such analyses! Generally speaking, all analyses of coprolites showing more than 59 or 60 per cent. of phosphates are to be suspected, and the buyer had better inquire what method of analysis has been adopted.

II. Separation by Means of Iron.—The solution of phosphate in acid is treated with perchloride of iron and acetate of soda, and then boiled; the whole of the iron precipitates, taking with it all the phosphoric acid present. One of two plans is then followed. If a known quantity of iron has been added, the precipitate is burnt and weighed; the amount of iron used deducted leaves the amount of phosphoric acid present. Or, the precipitate is dissolved in hydrochloric acid, tartaric, or, better, citric acid added, and the phosphoric acid precipitated by magnesia and ammonia. The first mode of procedure is the speedier, but cannot be followed if the phosphate itself contains iron or aluminium; the second plan is applicable in all cases. Separation by means of iron is a reliable method; its successful use requires a little experience; the chief practical difficulty is the bulk of the ferruginous precipitate.

III. Separation by Means of Lead.—The nitric acid solution of the phosphate is treated with an excess of acetate of lead, and the precipitate, after warming, washed by decantation. The phosphate of lead is then decomposed by treatment with oxalic acid; or it is dissolved in nitric acid, and the lead thrown down either with sulphuretted hydrogen or sulphuric acid. After thus removing the lead, the phosphoric acid is determined with magnesia, a little citric acid being first added if iron were originally present. This method is simple and good, and applicable to the analysis of all the phosphates employed in agriculture.

IV. Separation by Means of Tin.—The concentrated solution in nitric acid is digested with a weighed amount of *pure* tin foil, in quantity about eight times that of the phosphoric acid supposed to be present. The precipitated binoxide of tin carries with it all the phosphoric acid; it is collected, washed, burnt, and weighed, the excess over the oxide from the tin used being phosphoric acid. This method is simple, but in the form here described is not susceptible of the highest degree of accuracy. It is not available in the presence of much iron.

V. Separation by Means of Mercury.—The nitric acid solution is evaporated to dryness with excess of metallic mercury, the residue collected and washed, mixed when dry with carbonate of soda, and very gradually heated to fusion. The fused mass is dissolved in water, neutralised with acid, and the phosphoric acid precipitated by magnesia. This method is said on high authority

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[*] Extracted from "Practice with Science." Part I.

to be perfectly accurate; it has not been much used for agricultural purposes.

VI. Estimation as Phosphate of Uranium.—The acetic solution is precipitated by acetate of uranium, the solution boiled, the phosphate of uranium washed by decantation, ignited, and weighed. The method is available only when iron and aluminium are absent; when properly performed it admits of great accuracy.

VII. Separation by Means of Sulphuric Acid.—The acid solution of the phosphate is evaporated with excess of sulphuric acid, the whole then treated with alcohol, and the sulphate of lime separated by filtration. The phosphoric acid is then determined with magnesia. This plan is an old one, and now little used.

VIII. Separation by Means of Oxalic Acid.—In this method the solution, slightly acid with hydrochloric acid, is treated with an excess of oxalate of ammonia, the oxalate of lime separated, and the phosphoric acid in the filtrate determined with magnesia, citric acid being added if iron or aluminium be present. This method requires some experience to insure success. The *safest* plan is to keep the solution fairly acid during the precipitation by oxalate of ammonia, and at last to re-dissolve the magnesian precipitate in dilute acetic acid, and after separating any oxalate of lime it may contain, to re-precipitate. With these precautions, the method is perfectly reliable.

In reviewing these methods, we see that only Nos. II., III., and VIII., with perhaps V., can be recommended for the analysis of coprolite, or other phosphate containing iron and aluminium. For general purposes Nos. III., VI., and VIII. appear to deserve most commendation.

PROCEEDINGS OF SOCIETIES.

SOCIETY OF ARTS.

CANTOR LECTURES.

"*On some of the most important Chemical Discoveries made within the last Two Years.*"

By Dr. F. Crace Calvert, *F.R.S., F.C.S.*

Lecture 1.

Tuesday, April 4, 1865.

On the Discoveries in Chemistry applied to Arts and Manufactures.—In this lecture I intend to treat of chemistry applied to the arts, and more especially to some of the discoveries which have been made within the last two years. Many of these will appear to you to be incomplete, but if complete they would not be new, for seldom are discoveries perfected at once. They are generally the result of many years' study, and of the thoughtful consideration of several men.

The first part of this lecture will have reference to some of the applications which the laws of light have received during the last few years; and it will, I hope, convince you of the necessity of every one engaged in the arts making himself acquainted with all the laws connected with the phenomena of light, to enable him to appreciate the discoveries which have been made, or to assist him in improving upon those which are already known, as they are constantly receiving the most valuable applications in the arts and manufactures. Thus, for example, M. Donné has applied the properties of light to ascertain the relative values of milks by the amount of cream they contain, and this he effects by an instrument which he calls the lactoscope. Duboscq Soleil has applied with great success one of the most complicated laws of light—viz., polarised light—to the commercial estimation of the various qualities of sugars. By this process the sugar refiner, or any other person interested in that product, is enabled to ascertain in half an hour exactly the amount of crystallised sugar there is in a given sample, as compared with the quantity of non-crystallisable, or what is commonly called treacle. M. Duboscq Soleil's apparatus is considered so accurate that the French Government has adopted it to determine the value of raw sugars imported into the country, and the customs duties are levied upon the results given by this instrument. I may further add that this apparatus, called a "Polarising Saccharometer," is based on the peculiar property which light has when polarised, or when its rays are received at an angle of $35^\circ 25'$ on a plate of tourmaline or a mirror. M. Duboscq Soleil's apparatus enables him to work with polarised light, which presents the various colours of the spectrum, in such a way as to enable him thereby to determine, as I have already stated, the amount of crystallisable sugar in any given quantity of the article sufficiently accurately for all commercial purposes.

It is impossible for me, in a single lecture, to attempt to give you an idea of the various improvements which have been effected, even within the last two years, in the arts of photography, Talbotype, photozincography, glyphography, or other processes which are due to the action of light on sensitive surfaces; but you will find an excellent paper on the application of photography, and also of light to sensitive surfaces as applied to the art of engraving, in vol. xiii., page 131, of the *Journal of the Society of Arts*, by Mr. S. T. Davenport, under the heading of "Engraving and other Reproductive Art Processes." Still there are two discoveries which appear to me to deserve passing notice—viz., the carbon process of Mr. Swan, and also the process discovered by M. Villème, and now carried on in London by a company, by which the operator is enabled not only to take the photograph of a person, but to produce a statuette giving a full representation of the figure itself, and a far more accurate personification than could be produced by any sculptor, and that at a cost of as many shillings as the sculptor would expect pounds. But the most important series of researches which have been made of late years in connection with photography, and to which I deem it my duty to call especial attention, are such as to acquire more and more importance as they are more developed; I therefore feel convinced that any one who will devote his talents to the study of this particular branch of photography will in time be amply rewarded, and of this there can be no doubt when we consider the results already obtained by the labours of only two or three gentlemen. I refer to the re-production of the various colours of the spectrum upon sensitive surfaces. In 1838, Herschel was the first to publish a paper on the various colours which chloride of silver is susceptible of taking under the influence of certain coloured rays of light. Mr. Robert Hunt also published in 1840 a paper referring to the subject; but the most complete series of researches on the subject of the re-production of the colours of the spectrum, and which led to a process by which several of the colours of the spectrum could be produced on a sensitive surface, is due to Edmund Becquerel. The results arrived at by this gentleman were so remarkable that they drew the attention of the whole scientific world; and the following is an outline of the processes which were applied by him to obtain this interesting result. He took a daguerreotype plate or a silver-plated one, and having dipped it in a weak solution of chlorine, or, what was still better, a weak solution of hydrochloric acid, by connecting it with the poles of a battery, the brilliant silver surface acquired different tints, passing gradually from an opaque white to a black tint. He also observed that the tint best suited to obtain favourable results was when the plate had acquired a pearlish pink; and although he found that the plate so prepared, when placed in the camera obscura, assumed the colours composing the spectrum, still they were faint, but he remedied this defect of intensity of tints by heating for several hours to a temperature of 95° to 100° the chlorinated plate, and then submitting it to the influence of the various colours composing the spectrum. Further, in the course of his studies he made the important observation that he could replace the peculiar action of heat on his prepared daguerreotype plate by exposing it to the rays of the sun under a sheet of paper which had been steeped in an acid solution of sulphate of quinine. The effect of this was that the plate of silver assumed an intense white colour, nearly resembling that of paper; whilst, if the protective paper had not been used, the silver plate would have gradually acquired a dark tint, and would have lost the whole of its sensitive properties, the protective paper having the power of arresting completely the most refrangible rays of light, especially those which are beyond the line H of the spectrum. Notwithstanding M. Edmond Becquerel's ardent hopes to find a method which would enable him to fix on a sensitive surface the various colours of the spectrum, still he failed, for they faded immediately they were exposed to the direct rays of light, and could only be preserved in obscurity. But there is one gentleman who deserves great praise for the extraordinary perseverance which he has shown in this class of investigation. I mean the nephew of the discoverer of photography, M. Niépce de Saint Victor. Although I will not enter here into the details of these valuable researches, as they can be found in the *Comptes Rendus de l'Académie des Sciences*, still I may just be allowed to state that he has not only by the following process obtained far more brilliant colours than those first produced by M. Becquerel, but has succeeded in re-producing on sensitive plates the various colours of coloured surfaces, such as are presented by fabrics, flowers, &c., and further, he has lately been so fortunate as to re-produce on his plates yellow and black tints, which had resisted all previous attempts. To give you an idea of the facts arrived at by this gentleman, I may state that he has succeeded in so fixing upon sensitive surfaces the various colours of the spectrum, or of coloured surfaces, that they will bear the action of diffused light for several days. In fact, I have seen photographs which re-produce faithfully a small doll dressed up in various colours, and in which even the most minute ornament could be traced, and what is certainly not less interesting was the re-production of the iridescent colours of the peacock's feather. To obtain these marvellous results, M. Niépce de Saint Victor takes a daguerreotype, or silver-coated plate, and dips it into a weak solution of hypochlorite of sodium, having a specific gravity of 1·35, until it has assumed a bright pinkish hue. The plate is then covered with a solution of dextrine, saturated with chloride of lead; it is then dried, and subsequently submitted to the action of heat, as in M. Becquerel's experiment, or under the screen of sulphate of quinine, also referred to above. The plate is then ready to be placed in the camera obscura, and to receive the colours of the spectrum, or representations of nature, such as flowers, as well as certain colours produced by man. Lastly, he succeeds in increasing the stability of the colours developed on the sensitive surface, by covering the plate with an alcoholic solution of gum benzoin, and M. Niépce gives the name of Heliochromy to this branch of photography.

During his lengthened researches, M. Niépce de St. Victor has made two series of observations which I deem it my duty to lay before you—viz., that he can produce with facility, on prepared plates, the binary colours of the spectrum—viz., orange, violet, indigo, and green, if those [illegible] are natural; but if they are artificially produced [illegible] mixing of two of the primary colours, as red and [illegible] or orange and blue, and yellow or blue, he cannot [illegible] the binary colour, but only one of the two [illegible] employed by the artisan to prepare them. Thus, [illegible] he can reproduce the natural green of mala[illegible] and the beautiful colour known as Scheele's green, [illegible] he cannot do so with a mixture of Prussian-blue and yellow chromate of lead, the blue only reappearing. These facts enable him to explain why, in ordinary photography, the leaves of plants always appear black, and why, when he attempts to fix on his plates the colours of leaves, they have a bluish hue, the yellow portion of the colour not being reproducible.

M. Niépce has made another series of observations which deserve notice—viz., that when a plate, as prepared by his process, is dipped in an alcoholic solution of substances susceptible of imparting a colour to flame, such, for example, as strontia, which communicates a red hue to it, or baryta, which gives a yellowish-green colour, the prepared plates when exposed in the camera will assume the same colour as the salt which they have on their surface would impart to the flame of alcohol; and if a salt of copper be used, which has the property of communicating a variety of tints to the flame of alcohol, the plate also will assume a variety of tints when exposed to the action of light: and during a certain period of his lengthy researches M. Niépce availed himself of this curious phenomenon to obtain coloured plates in the camera. They are not only interesting as reproductions of art, and as a feat of extraordinary skill in the progress of photography, but they are especially so because in time they will lead to methods which will enable us to communicate to our little children perfect and correct views of our time, and other interesting facts connected with the period in which we live.

All persons interested in the progress of photography will find full details of the new processes for reproducing vitrified photographic plates in vol. 60, page 1239, of the *Comptes Rendus de l'Académie des Sciences*, 1865; these I omit, as they are purely technical, and have only an interest for those immediately engaged in that branch of the photographic art.

I shall now have the pleasure of calling your attention to a most important series of researches published by Professors Bunsen and Roscoe; but, to enable you to appreciate their value, it is necessary that I should make the following remarks:—It is now well known that the solar spectrum is composed of three primary colours—blue, yellow, and red; and, also, of four complementary or binary colours—viz., orange, green, indigo, and violet. It is also known that those colours represent different properties or qualities of that universal fluid called ether, which, I may say, was generalised by Sir Isaac Newton under the name of gravitation, on which the whole of the planetary system is based, and which gives to the universe its harmony and stability. This fluid is susceptible, under certain influences, as those generated by the sun, of being set in vibration, and thus are generated heat, light, and chemical rays; and further, as there is no chemical action without a corresponding production of electricity, it follows that electricity, as well as magnetism, may be considered as a mere modification in the vibrations of the same fluid. Therefore we may truly say that all the imponderable fluids called Light, Electricity, Heat, Magnetism, and Force have all the same origin—namely, the fluid called ether, and which, according to the nature of the vibrations, developes or renders palpable to our senses one of those fluids. In fact, I feel convinced that this unique fluid is not converted into those diverse fluids by special modifications of its own vibrations, but that they only become manifest to our senses when it has imparted its own or special vibration to the particles of matter, and that it is the peculiar vibration which it imparts to the molecules of matter that developes in the molecules themselves such a mode of vibration as gives birth to what we call light, electricity, magnetism, heat, and force. In fact, there is no doubt, from the researches of Dr. J. P. Joule, Professors William Thomson, Mayer, and others, that heat and force are the same fluid, for Dr. Joule has given us the exact measurement of that force. He has demonstrated that the amount of heat necessary to raise one pound of water one degree in temperature would, if applied mechanically, be competent to raise one pound weight 772 feet high, or it would raise 772 pounds one foot high. The term "foot pound" has been introduced to express in a convenient or systematic way the lifting of 772 pounds to the height of one foot. Thus the quantity of heat necessary to raise the temperature of a pound of water one degree being taken as a standard, 772 foot pounds statute, is what is called the mechanical equivalent of heat. Dr. Tyndall, in his valuable work on "Heat considered as a Mode of Motion," gives many interesting examples of the conversion of heat into force, and *vice versâ*. For example, he cites the following theory of Professor Thomson, who assumes that an immense amount of force is converted into heat when meteoric matter is attracted to the surface of the sun by the molecular attraction called gravitation; that the force generated by the immense velocity with which meteoric matters travel towards the sun, becomes converted instantly by its contact with the sun into heat; and further, he considers that the showering of meteoric matter, as well as that of the zodiacal lights on the sun's surface, are sufficient to account for the immense heat which he supposes the sun's surface to possess. I must say that I do not believe that the sun possesses much heat or light. I believe that it is only an immense mass which, by its size as compared with the rest of the planetary system, becomes the centre of gravitation; and that there exists between it and the planetary bodies a constant state of attraction; that the fluid called ether, which represents the force called gravitation, is in a constant state of activity throughout the universe, and brings about that godly and admirable harmony which pervades it; and although the ether filling space can be considered in a constant state of action or vibration, and convertible into the fluids which we call heat, light, electricity, and magnetism, still these fluids only become manifest to our senses when they put into vibration the particles of matter, or produce, according to their peculiar vibration, the phenomena of light, electricity, magnetism, heat, and force; for if heat is convertible into force, as asserted by the researches of the eminent *savants* above stated, why should not the production of other fluids be due also to similar phenomena? If it be true, as Joule, Thomson, and others contend, that force and heat are due to the vibration of the molecules of matter, and that, according to the rapidity of the vibrations of such atoms (imparted to them by the vibrations of ether), one or other of these forces is engendered, why should not the manifestations of other fluids be traced to similar causes? In fact, no doubt can exist, in my opinion, with respect to electricity and magnetism, for if their manifestations to our senses were owing to the vibration of a universal force, it would affect all bodies in the same way and in the same degree. Now, this is not the case, for there are good and bad conductors. Therefore it follows that the atoms composing matter—or more so, their nature—have an influence on its degree of manifestation. The same with magnetism; for we find oxygen to be magnetic, and nitrogen non-magnetic or diamagnetic. Thus, it appears to me from these facts, which might be multiplied if time permitted, that the manifestations of heat, force, electricity, and magnetism are not peculiar and distinctive fluids, but are due to the modification in the mode of vibration of the universal fluid called ether, which imparts to matter its peculiar undulations, and that these forces are only made manifest to us when the vibrations come into contact with solid matters such as compose the atmosphere or the earth. Therefore, I am of opinion that there is no light, heat, electricity, or magnetism beyond the limits of the atmosphere which surround the earth; but that when the ether, which is in a state of vibration, comes in contact with the particles of matter composing our atmosphere, it then communicates one of its own peculiar vibrations to these particles; then they, by their vibrations, become luminous. If this theory is correct, it follows that the production of the phenomena of light is due to the vibrations of solid matter, and not to the vibrations of the ether, as is assumed by the philosophers of the day.

I very well know that these views of mine are completely in contradiction with those entertained by most of the philosophers of the day; but still I hope to be able to publish a sufficient number of scientific researches, as well as to draw attention to such a number of physical, chemical, and astronomical facts as may, even if not proving the truth of my views, at all events, I hope, deserve some attention.

(To be continued.)

ACADEMY OF SCIENCES.

October 23.

M. Boussingault continued his memoir "*On the Functions of Leaves.*" The first series of experiments now described are on the action of certain vapours on leaves. The few experiments made induce the author to believe that vegetable essential oils for the most part exert no well-pronounced deleterious influence on leaves, but oil of turpentine does appear to diminish the decomposing power of oleander leaves. The next series describe the action of the vapour of mercury. When leaves are placed under a glass bell with their peduncles immersed in mercury, it would appear that they are completely deprived of their power of decomposing carbonic acid; but when the leaves are not directly in contact with mercury, but still exposed to the metallic vapour, the decomposing power is lessened, but not completely destroyed. The foregoing experiments were conducted in the light, but the author has proved that leaves kept in the dark in contact with mercury transform quite as much oxygen into carbonic acid as a leaf similarly placed in confined air will when not in contact with mercury. M. Boussingault next describes how he collected the gases evolved from the branch of an oleander still attached to the plant. The gas escaped from the branch at the rate of 3·3. c. c. per hour, and in twenty-three hours there were collected 76·93 c. c. of a mixture having the following per centage composition: nitrogen, 88·01; oxygen, 6·64; carbonic acid, 5·35. This gas, the author says, is similar in composition to that confined in strongly manured soil. On reaching the leaves with the sap it only brings carbon to the vegetable organism, or, as the author said at the commencement, carbonic oxide, hydrogen resulting from the simultaneous decomposition of carbonic acid and water. Oxygen is evolved, and COH remain, representing the composition of glucose, $C_{12}H_{12}O_{12}$, which, by fixing or parting with the elements of water, give rise to the bodies designated as carbo-hydrates, sugar, starch, and lignine, and which a leaf elaborates as long as it is stimulated by a ray of light. The author then quotes some illustrations in support of this view of the functions of leaves.

M. P. Collin communicated some interesting "*Experiments on Animal Heat, and Specially on the Temperature of Arterial Compared with Venous Blood.*" The author has found that the two bloods have never the same temperature, even in arteries and veins in close proximity to each other; the arterial blood is always warmer than the venous. Thus, the blood of the carotid artery is from a-half to two degrees warmer than the blood of the jugular vein. A similar difference of temperature is to be observed in the blood of the femoral artery and the saphena vein. The author has found also that the temperature of the arterial slowly decreases from the aortic trunk towards the capillaries, while the heat of venous blood rises as it makes its way to the central organ. Every large vessel appears to have its proper temperature: the superior vena cava presents the minimum, the portal vein the maximum, while the inferior vena cava presents an intermediate degree. In general, also, the author found that the blood on the two sides of the heart showed small differences of temperature. From the remarkable fact that in the heart the temperature of the arterial blood surpasses that of the venous, the author draws the conclusion that the blood becomes heated as it traverses the pulmonary tissue. In fact, he argues, if, after parting with caloric to heat the air in the bronchi, as well as to vapourise the products of transpiration, it still, notwithstanding these two causes of cooling, is warmer when it issues from, than when it entered the lung, it must be because heat was disengaged by the action of the air. Thus the blood changes effected in the lung must be considered as one source of animal heat.

M. Béchamp presented a note "*On the Physiological Exhaustion and Vitality of Beer Yeast.*" The author washed and washed globules of yeast until they appeared to be mere envelopes of cellules, and found that they still retained the power of changing cane-sugar into glucose, and setting up the alcoholic fermentation, which proves, he considers, that the property of setting up fermentation resides in the properties of the living cellule, and is a consequence of the act of nutrition of this cellule. We may give the author's paper in detail on a future occasion.

We may call the attention of our medical readers to some "*Experiments on the Transfusion of Blood,*" by MM. Eulenburg and Landois, which would appear to have some value. We shall only mention those which show that animals poisoned with opium may be kept alive by practising what the authors call combined transfusion, which consists in drawing off the poisoned blood and substituting for it healthy blood from an animal of the same species. Other experiments showed that animals deprived of food may be kept alive by regularly repeated transfusions.

M. Monier sent a note "*On the Organic Matters of insalubrious Waters.*" He says that he has the honour of presenting to the Academy a practical method of proving the presence of organic matters in any water whatever; and, moreover, determining the proportion of these insalubrious substances. The method is more useful and practical than novel. The author employs a standard solution of permanganate of potash. His experiments prove the disappearance of organic matter in running water.

MM. Hugo Schiff and E. Becchi presented a note "*On Boric Ethers.*" We shall give this note at length next week.

M. Niépce de Saint Victor presented a note "*On the Production of Blacks in Heliochromy.*" The author obtains blacks by four processes. The first, he says, offers the most interest, because by it pure blacks may be obtained either in a camera or by contact; these results are obtained by acting on the chloride of silver with a very alkaline liquid. The second consists in developing a black but slightly indicated, and this he calls black by the reduction of chloride of silver. The third consists in submitting a slight black to the action of diffused light; this result the author calls black by the alteration of exposed chloride. Lastly, a fourth process gives a dark tint approaching black by acting successively on a sensitised plate with two complementary colours, as blue and orange or green and red. In his next memoir the author intends to describe the new modes of preparing the plates; and will soon show stereoscopic proofs, on which will be seen not only all the colours, with blacks and whites, but also the lustre of metals, and the scintillations of precious stones.

A New Decanter.—A very ingenious contrivance has been made by MM. Toselli and D'Allmagne, of Paris. They blow a small globe within a decanter or claret jug. This globe, which has its opening at the side of the larger vessel, serves to hold a freezing mixture to cool wine or water in summer, and in winter may be filled with warm water to take the chill off Burgundy or port.

NOTICES OF BOOKS.

Saint Bartholomew's Hospital Reports. Edited by Dr. Edwards and Mr. Callender. Vol. I. London: Longmans and Co. 1865.

Clinical Lectures and Reports. By the Medical and Surgical Staff of the London Hospital. Vol. II. London: Churchill and Sons. 1865.

The two books whose titles are seen above, it is hardly necessary to say, are chiefly occupied with matters which do not concern chemists as chemists, whatever the interest they may have for individuals liable, like the rest of mankind, to all the ills which flesh is heir to. Each, however, contains two papers which legitimately call for notice in a purely chemical journal. In the Reports of St. Bartholomew's Hospital we find recorded two cases of poisoning by Mercuric Methide, and also a Note on Hippuric Acid, by Dr. Odling; and in the volume issued by the London Hospital staff there are two papers by Dr. Letheby. Of these papers we propose to give a short summary.

The two cases of poisoning by mercuric methide are unique, and are here for the first time made public, although they have formed the subject of conversation among chemists in London for months past. We dwell on them at some length, that others who engage in the preparation of these bodies may be duly cautioned of the risks they run, and advised of the precautions necessary to be taken to avoid such risks.

An account of the method by which mercuric methide is prepared by Messrs. Frankland and Duppa will be found in Vol. VIII. of the Chemical News, page 262, and in the *Journal* of the Chemical Society for December, 1863, and may very properly be abridged here. A mixture of ten parts by weight of iodide of methyl and one part of acetic ether is treated with sodium amalgam, the flask containing the ingredients being alternately agitated to promote the reaction and plunged into cold water to moderate the rise in temperature. To the neck of the flask is attached a small upright Liebig's condenser to arrest the vapour of iodide of methyl. When the reaction has terminated the contents of the flask are distilled, and the ethereal distillate, after separation of the water, first agitated with alcoholic potash to remove the acetic ether (which took no part in the reaction), and afterwards well washed with water. The product now exhibits the boiling-point and other properties of mercuric methide.

We may presume that, in ignorance of the poisonous qualities of any vapour escaping, all these operations were conducted in the open laboratory, and not under a hood or in a closet. The consequences to the operators are thus recorded; we of course greatly abridge the reports:—

C. U., aged 30, admitted into Matthew Ward, February 3, 1865, under the care of Dr. Jeaffreson. He is a German, assistant in the laboratory of St. Bartholomew's Hospital. For nearly three months past he has been engaged in the preparation of mercuric methide, and has complained during the time of impairment of sight. Two days ago he was seized with numbness of the hands, deafness, and great weakness, and found that his gums became sore. On his admission to the hospital he complained of a feeling of general debility and inability to stand without support. He moved both arms and legs slowly and with some difficulty, but sensation in them was unimpaired. He spoke indistinctly, and was deaf. His gums were swollen and tender.

The treatment we shall not concern ourselves with at present. It will suffice to say that the patient went from bad to worse, that the odour of his breath and body got very offensive, that he became at times maniacal, and that he died on February 14.

The post-mortem examination revealed a generally congested state of the brain, but especially of the grey matter; the liver congested, but apparently natural; the kidneys also congested, soft, and weighing about six ounces each. It would have added considerably to the interest of these observations if we had been informed whether or not these organs contained mercury; but no chemical examination appears to have been made; at all events, none is recorded. There can hardly be a doubt, however, that mercury would have been found in them.

The next case is perhaps of still greater interest. T. C., aged 23, admitted March 25, 1865, under the same physician. A delicate-looking young man of fair complexion. He had been engaged as assistant in the laboratory of St. Bartholomew's Hospital for the past twelve months, during the last four of which he has not been well. (The dates should be noted here.) In January last he was employed for about a fortnight in the preparation of mercuric methide, but has not worked with this or at any other mercurial compound since that time. States that he has a taste of brass in his mouth. His breath is offensive, his gums are spongy, and his sight slightly impaired. Hearing appears to be entirely absent. Powers of taste, speech, and smell much impaired. Sensation less than natural. Moves his limbs perfectly, but slowly; can grasp but imperfectly, and drags his legs after him in walking. Has perfect control over his sphincters. We need not linger over the daily record of his progress from bad to worse. The report ends on July 4, when his condition is thus described:—"He is quite idiotic, recognises no one, is deaf, and unable to speak any words, but mutters, cries out or laughs, and is frequently violent, and his limbs move convulsively. His bowels are in general confined; motions and urine always passed involuntarily." In this condition we believe he still remains.

It is much to be regretted that these interesting cases have been recorded entirely without comment, and it would appear that for aught that has been learned from their sufferings, beyond the symptoms, these unfortunate martyrs to science will have died in vain. There can be no doubt that we have all the symptoms which have occasionally been observed in the case of water-gilders and quicksilver miners, but greatly intensified. It must be remembered that mercuric methide contains 87 per cent. of mercury, and it would seem that the peculiar combination in which it is presented facilitates the absorption of the metal, and enables it, so to speak, to penetrate the system more profoundly. Whether nature makes any spontaneous effort at the elimination of the poison we are not informed.

This recalls us to the medical treatment to which the patients were subjected. We remark that soon after his admission to the hospital, each one had iodide of potassium administered to him. With what idea this salt was given is not stated, but it probably was intended to be an eliminating agent. How far we are justified in assuming it as a *propter hoc* that each one after taking the iodide seems to have become rapidly worse, we are unable to say; but on this point we may quote some curious remarks of Melsens. This writer observes that the first effect of the administration of iodide of potassium in cases of mercurial intoxication is sometimes to revive and exaggerate the action of the poison. This, however, he adds is a condition necessary to a perfect cure, and suggests the continuation of the remedy in larger and larger doses.*

Melsens, indeed, adminsters the iodide in very large doses, and states that it is never followed by any ill effects of its own when perfectly pure. He states that he has proved the elimination of the mercury in combination with the iodide by the urine in cases of mercurial palsy, and also the absence of the metal in that excretion after a cure was effected. But Melsens' writings on this subject are no doubt well known, and we need not refer to the matter further.

We hope that the knowledge of these two lamentable cases will prevent the recurrence of similar accidents, and that they will remain as characterised in this report—unique.

With regard to Dr. Odling's note on Hippuric Acid, we need only say that he here brings forward the same views of the constitution of that acid which he illustrated with so much skill in his lectures at the College of Physicians, and which will be found at page 66 of our present volume.

A notice of Dr. Letheby's papers must be reserved for another occasion.

Journal für Praktische Chemie. No. 14. 1865.

The first article in this number is a valuable "*Contribution to the Knowledge of Graphitic Acid,*" by Dr. F. Gottschalk. This acid, discovered by Sir B. Brodie, our readers will remember, is formed when pure graphite is treated with chlorate of potash and the strongest nitric acid. This treatment must be repeated several times. After the first digestion the graphite remains black; but on subsequent digestions it passes through different shades of green, to a sulphur yellow, the colour of the graphitic acid. The acid is carefully washed and dried under the air-pump, or at 100° C. Gottschalk gives as the formula of graphitic acid $Gr_6H_6O_{18}$, which differs from that of Brodie $Gr_6H_6O_{15}$ by $3O$ (graphite, $Gr = 33$). Under the microscope graphitic acid appears as minute transparent scales. It blackens in the light. Water dissolves a minute quantity, so does alcohol; but it appears to be insoluble in nearly every other menstruum. Paper soaked in the aqueous solution becomes reddish brown on parts exposed to the light; but the parts protected from light remain quite white. Possibly the study of this substance may lead to the discovery of a process for carbon printing. The chemical reactions of graphitic acid are not very distinct, and the author's account of them only confirms the description of Brodie.

The other papers in this *Journal* have been noticed before, with the exception of a short notice of a communication by Professor Boettger, "*On the Preparation of Metallic Peroxides,*" who states that the quickest method of preparing these bodies is by digesting for some time at 100° C. the recently precipitated hydrated oxides with a solution of hypochlorite of soda containing some free soda. In this way he has prepared the peroxides of lead, bismuth, manganese, cobalt, and nickel, as well as that of copper. We shall give this notice at length in another place.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

2293. F. Tollhausen, Boulevart Magenta, Paris, "A new fire-work producing instantaneously the forms of serpents, and other forms of a like nature."—A communication from F. Barnet and C. A. Roussille, Rue de Rivoli, Paris.—Petition recorded September 7, 1865.

2404. S. Trotman, Lyme Street, Camden Town, "Improvements in the manufacture of paper."—Sept. 21, 1865.

2448. W. Unwin, Sheffield, "Improvements in the manufacture of iron."—September 25, 1865.

2456. N. Korslumoff, Birmingham, "Improvements in the manufacture of cast-iron, malleable iron, and steel."—September 26, 1865.

2490. A. M. Bennett, Oakfield, Gateacre, near Liverpool, "Improvements in apparatus for ascertaining specific gravities and the bulk of solids, and also for other similar uses."

2494. J. Smith and W. F. Bath, Birmingham, "Improvements in apparatus for heating, evaporating, and cooling liquids."—September 28, 1865.

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* See "Mémoire sur l'emploi de l'iodure de Potassium, pour combattre les affections saturnines et mercurielles," &c. Bruxelles. 1865.

2506. J. De Weweime, and A. Verschaffelt, Ghent, Belgium, "Improvements in dyeing."—Sept. 29, 1865.

2516. J. W. M. Miller, Southsea, Hampshire, "An improved process for preparing skins and hides or leather, so as to render such substances waterproof and more durable than heretofore."—September 30, 1865.

2528. S. C. Salisbury, New York, U.S.A., "Improvements in blast-furnaces."—October 2, 1865.

2536. R. A. Brooman, Fleet Street, "Improvements in preparing red and violet colouring matter, for dyeing and printing silk, wool, cotton, and other textile, vegetable, and mineral substances."—A communication from P. Chevalier, Lyons, France.—October 3, 1865.

2544. A. Craig, Leeswood-hill Colliery, Mold, Flintshire, "Improvements in apparatus for extracting oil from coal, shale, and other minerals."—Oct. 4, 1865.

2590. T. Campbell, Jamaica, "Improvements in evaporating and distilling liquids, and in the apparatus employed therein."

2591. W. Harris, Wimbledon, Surrey, "Improvements in tanning or treating hides applicable for machine bands and other purposes."

2592. J. B. Thompson, Rothwell Street, Regent's Park Road, "Improvements in coating iron and steel with gold, silver, platinum, or copper."—Oct. 7, 1865.

2620. J. Crutchett, Washington, U.S.A., "Improvements in the manufacture of gas."—Oct. 11, 1865.

2646. R. A. Brooman, Fleet Street, "An improved liquid compound for purifying sea and other waters."—A communication from L. Daryon, Armentières, France.

2648. J. De Witt Brinckerhoff, New York, U.S.A., "An improvement in preparing paper and the surfaces of other materials for use in photography."—Oct. 13, 1865.

2660. A. J. Mott, Liverpool, "Certain improvements in the production and uses of carbonic acid gas."

2662. W. Clark, Chancery Lane, "Improvements in the treatment of copper ores in the manufacture of copper."—A communication from F. Le Clerc, Boulevart St. Martin, Paris.—Oct. 16, 1865.

2674. C. G. Lenk, Dresden, Saxony, "An improved process for purifying and preserving water."—Oct. 17, 1865.

Notices to Proceed.

2314. J. Casthélay and N. Basset, Rue Ste. Croix de la Bretonnerié, Paris, "Improvements in the manufacture of oxalic acid."—Sept. 9, 1865.

1600. C. J. Collins, Upper Thames Street, "A new or improved artificial fuel."—Petition recorded June 13, 1865.

1636. A. Klein, Leipzig, Saxony, "Improvements in gunpowder for mining and war purposes."—A communication from G. A. Neumeyer, Döbitz, Saxony."—June 17, 1865.

1703. C. Worssam, Commercial Wharf, Kingsland Road, and G. Evans, Gloucester Place, Portman Square, "An improved pulping and compressing machine for the treatment of peat as a fuel and gas for illuminating purposes."—June 26, 1865.

1791. J. W. Swan, Gateshead, "Improvements in the production of printing surfaces by photographic agency, and in obtaining prints therefrom."—July 6, 1865.

Dr. Sheridan Muspratt and the Saline Chalybeate Spring.—The water from the spring in our Cheltenham Gardens, which some months ago was found to contain so much protochloride of iron when submitted, by Dr. Muspratt, to analysis, has proved most valuable as a curative agent in many cases of great debility and constitutional weakness. Dr. Kennion is, we are informed, very eulogistic as regards its efficacy. It is a "great discovery," and, from what we have heard, is a most remarkable spa, as this salt has not been detected in any other potable water.—*Harrogate Advertiser.*

CORRESPONDENCE.

M. Kopp's Processes for the Utilisation of Alkali and Chlorine Wastes.

To the Editor of the Chemical News.

Honoured Colleague,—I have read in No. 306 of the Chemical News a notice, perhaps a little too severe, of my memoir on the utilisation of soda and chlorine residues which I have sent to the Academy of Sciences. This notice, no doubt inspired by the published *resumé* of my paper, could not take account of the special character of the work. My aim was not, and never pretended, to give new applications or new modes of treatment of these residues, but to describe in detail the entire system of measures by means of which, with the least expenditure of labour, and with the greatest economy, the *whole* of these residues can be rendered inoffensive, and made to yield products which may be utilised and make the operations profitable.

I do not hesitate to assert that all the processes hitherto employed only extend to the *partial* utilisation of the residues, and that some of them, among others that of Messrs. Townsend and Walker, such as have been described, are impracticable on a large scale.

As you have represented me as borrowing from these gentlemen, allow me to remind you that MM. Townsend and Walker only patented in 1860 and 1861 processes which I had described in 1858 (*vide* Hofmann's Report, pp. 32—38). The first proposition of these gentlemen to dechlorinate the residues of chlorine by means of a little soda waste is really practicable. Some sulphur is obtained, and the operation may be accurately conducted on the large scale. Nevertheless, if it be carried on for several days consecutively the workmen suffer, particularly from an inflammation of the eyes, which compels them to leave off work. This effect of sulphuretted hydrogen I do not think has yet been noticed in print. It is necessary, then, to take special precautions to protect the workmen from the gases evolved during the dechloration.

The second proposition is simply impracticable on the large scale. Each *litre* of the chlorine residue, when saturated with soda waste, disengages at least two *litres* of sulphuretted hydrogen. In operating on 20,000 or 30,000 *litres* of such residues daily (the quantity produced in large works) we disengage into the atmosphere from 40,000 to 60,000 *litres* of sulphuretted hydrogen. This would not be endured in an inhabited country. It was attempted once only at Dieuze, and the effects for more than a league around were awful. The workmen were all made ill and fled, and birds fell dead, suffocated in their flight. It is, then, absolutely necessary that the saturation should be effected in closed vessels. We have therefore to discover and arrange an apparatus in which the operation can be conducted economically and the sulphuretted hydrogen used up immediately. After many expensive trials, such an apparatus has been contrived, and the best results obtained.

Theoretically there would not appear to be any difficulty in the matter, but the necessity of operating on such large quantities of liquors involves serious practical difficulties. There is one other point which must not be neglected, and which renders difficult the execution of the third proposition of Messrs. Townsend and Walker. When operating on neutral solutions of chlorides of iron and manganese, the soda residue acts but very slowly. The solution of the chlorides may be left in contact with an enormous excess of the waste for weeks, and only little of the sulphides of iron and manganese be formed. Frequently the manganese and iron remain in solution. To effect the precipitation it is necessary not only to agitate the mixture continually, but to pound the residues and even raise the temperature. And supposing all these difficulties overcome, the precipitates when obtained are not practically utilisable. In fact, I have always obtained products so much contaminated with oxides of iron and manganese, coke, sand, *débris* of bricks from the furnaces, &c., that on roasting the amount of sulphurous acid disengaged was very small and out of all proportion to the expense. This is never the case in my system of operation.

1. The dechloration is made according to the plan of Messrs. Townsend and Walker, and the sulphur obtained is utilisable.

2. The neutralisation gives as useful products only sulphuretted hydrogen and its derivatives. The deposits in the apparatus are rejected.

3. By precipitating clear and neutral solutions of the chlorides of iron and manganese by the equally clear solutions draining from the heaps of soda waste, I obtain precipitates of MnS and FeS, rich in sulphur, and containing none of the impurities mentioned above.

I venture to hope that these observations show that I have really studied the question, and have not reproduced processes already carried out and perfectly well known.

In my memoir I have described in detail all the apparatus, processes, and products, and given all the precautions necessary for successfully carrying on the operation. I have also given the theory of the several processes; and, if I do not deceive myself, the manufacturer will find valuable instruction in the work.

In conclusion, I hope that after the perusal of the memoir you will share the same opinion, and be induced to reconsider the judgment you have recently passed on my work. Accept, &c. E. Kopp.

Saverne, October 16, 1865.

[We have published M. Kopp's letter almost *in extenso*. Our esteemed correspondent must thank the meagre abstract of his memoir in the *Comptes Rendus* for the opinion we expressed. We hope soon to receive the entire work, and then shall be happy to give it all the attention which the importance of the subject and the value of the information demands.—Ed. *C. N.*]

Reports of the British Association.

To the Editor of the Chemical News.

Sir,—Knowing with what good success you advocated the publication in a separate form of the Jurors' Chemical Report of the International Exhibition, 1862, I am desirous of addressing you with the view of securing the weight of your influence in obtaining for us an earlier publication of the official report of the British Association. For many years past the volume of *Transactions* has been issued to the subscribers only after the expiration of twelve months from the date of meeting. To cite an actual case I may state that the last report (for 1864) was delivered at my address, which is within the metropolitan postal district, just ten days prior to my setting out for Birmingham in order to attend the recent meeting in that town.

I am prepared to admit the necessity of granting an adequate period of time for the production of some fifteen hundred copies of a work of such large dimensions; but this labour cannot surely demand greater exertions than are made constantly by the London press in dealing with other branches of literature. As a consequence of the delay now complained of, it has become a common practice for the authors to publish elsewhere the text of their communications, and it becomes necessary to search a wide field for the treasures which should never have been distributed but at the mine's mouth. Besides, so rapid is the advancement of science, it often happens that the isolated facts of one year have grown into a complete system, and may be viewed under a more favourable aspect than was contemplated at the time of their first announcement to the public; and yet we have often at this later period to rest content with the original, and necessarily imperfect, statement which was submitted to the meeting. It is, however, very satisfactory to know that the editors of the work in question have some discretionary power and authority to intercept the publication of experimental conclusions which later researches prove to be altogether erroneous. I am, &c. A Member.

P.S.—As a peculiarly apt illustration of the force of these remarks, it may be stated that Dr. Fairbairn's "Preliminary Investigation of the Mechanical Properties of the Proposed Atlantic Cable" did not reach us in print until *after the failure of the cable itself!*

On an Electric Theory of Ignition.

To the Editor of the Chemical News.

Sir,—While studying the electric theories of light and heat which appear to have been received by the physicists of this country, and I believe by those of foreign countries, as original, I write to inform your readers that the electric theories accounting for the phenomena of light and heat have been anticipated and partially developed, for I find in a work entitled "A New Theory of Natural Philosophy," by T. H. Pasley, which was published in 1836 (Whittaker), that most of the speculative points of physics are treated with, and some of them very ably. Among others may be mentioned matter, expansion, ignition, and motion. I know that were I to dilate upon these it would form a subject which would go beyond the limits of a letter, and will, therefore, only treat of ignition, as being the most suitable subject for your journal.

Ignition, according to the popular notion, is the act of lighting a body, but what occurs during the act comes within the pale of science, and is, consequently, of a technical character; the popular notion must be at once discarded, and a more tangible definition substituted.

Ignition cannot possibly occur in the absence of a supporter of combustion; a body may produce the sensation of heat, but not be ignited, as in the act of rubbing a body with another. In the work above mentioned the phenomenon of ignition is accounted for in the following manner:—"The state of ignition is effected by the body becoming de-electrised by fire to such an excess as fits it for acquiring the oxi-electric element as well as the medium of space or expanding medium. A piece of iron in the fire suffers loss of elementary matter first, in place of which it acquires the expanding medium, which is also that of vision, together with the oxygen element, the interstices of the atoms of the latter are such as exclude all returning electric matter, and as the medium of vision is more or less directly continuous through it, the ignited iron is more or less transparent."

What is meant in this extract by de-electrised is given in the author's words as follows:—"While a body exists as fire it is in a deficient state; it has been rendered unsated; it has been deprived of some of its elementary matter, hence the expression, de-electrised."

His (Pasley's) notions concerning the agency of electricity in producing the phenomena of fire and ignition are somewhat similar to the theory of light advanced in a paper on "A Dynamical Theory of the Electro-magnetic Field," by Professor Clerk Maxwell, F.R.S.,[*] and also bears a slight similitude to a theory of heat by Professor A. W. Norton.[†] All the electric theories which have been advanced as modern and original are, nevertheless, a development of those which have until recently remained embryonic. Electric atmospheres and electric atoms are by no means of modern date, and when they were proposed as scientific terms, they were rejected by the savans of science; but as science becomes further advanced they are gradually reclaimed from oblivion, and presented to us under a new light. The time will come when we must look for electric theories to remove the mist overhanging

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[*] Read before the Royal Society, December 8, 1864.

[†] *Phil. Mag.*, S. 4, vol. xxviii., p. 425.

most of the phenomena arising from heat and combustion. Should there be a theory advanced as original accounting for the action of flame, fire, combustion, &c., upon electro-magnetic laws, they have all been anticipated, and they will only be a revival of rejected theories, but in a further stage of development than they have hitherto been. The author above quoted imagines there to be an electric atmosphere surrounding all bodies, and it is by disturbing their equilibrium that the phenomena of electricity are produced, and he instances the fact that, to cause the electricity of an electric (plate) machine to be made manifest, it must be excited by friction which the conductor conveys to the Leyden jar, and therefore the plate is for the time being negative; but the equilibrium of its electric atmosphere is restored either by the earth or surrounding bodies. It is well known that when the machine is insulated upon a glass stool, the evolution of electricity is not so abundant as when in communication with the earth. The plate, therefore, only serves the place of a medium between the rubber and the earth; for what is abstracted from the plate is supplied by the earth.

By careful deductions, the phenomena of ignition can be made simple and easy of comprehension, and it is from the laws of electric equilibrium and disturbance that the deduction must be drawn. I have already exceeded the limits of a letter, and cannot enter further into a consideration of all the facts tending to support the electric theory of ignition; but should you favour me, as you have my former letters, I shall in a future communication resume the subject, and hope to bring some very cogent proofs of my assertions. JEREMIAS.

Red Lion Street, E.C., October 25, 1865.

Suggestion of a New Method of Barometric Registration.

To the Editor of the CHEMICAL NEWS.

SIR,—Though I do not doubt that photographic registration of the barometer is capable of great accuracy, yet it seems to me that there is still another method by which, perhaps, as great accuracy may be obtained, without the uncertain friction of a float, less liable to get out of order, and, consequently, more useful in the hands of the public. The principle is that of an independent, vertically-moving rod, registering instantly the point at which it comes into contact with the mercury of the barometer by thus forming an electric circuit. As an ordinary modification, I would suggest that every hour the rod should be lowered through the whole range of the barometer by clockwork. On the formation of contact, an electro-magnet, by means of an armature, would cause a point carried along with the rod to be indented into the registering paper, or other material, on a revolving drum similar to those already constructed for the purpose, to go for a week at a time.

For more accurate purposes still the drum might be made larger,—say five inches in diameter, and fourteen inches long, and divided vertically into two inches for every day. In this case the drum would have to be moved up on its vertical axis every time, through a division equal to the interval of registration,—one-twelfth of an inch for one hour, for instance—and the recording-point would remain stationary, except when acted on by the magnet. At the hour, a simultaneous motion would have to be given to the rod and the drum,—the first vertical and descending, the other horizontal and revolving—so that one inch and a-half of the one would be equal to fifteen inches circumference of the other. The electric current, by means of the magnet as before, would, at the instant of contact, record the point at which this took place, and, consequently, the height of the barometer at that time.

As I have no time for working out the idea, I have not gone into any mere practical details of construction or slight causes of variation to be allowed for, such as best form of battery; manner of communicating vertical motion to the rod; recovery of its position; effect of duration of contact; withdrawal of contact; or in the second and more difficult case, the practicability of giving a sufficiently accurate motion to the rod and drum, where the correctness of registration would depend on this; also the variation of interval introduced by the difference of time taken up by the movement of the rod before coming into contact with the mercury; correction for depression, &c.

Should any one think this suggestion worthy of their notice, and succeed in practically carrying it out, I should be glad to hear from them, and would only ask whatever credit may be due for the invention.

I am, &c. EDWARD CROSSLEY.

Park Road, Halifax.

P.S.—I find that Negretti and Zambra employ a fixed contact-point for adjusting the level of mercury in the trough; but I have nowhere heard of motion being given to a contact-rod for purposes of registration.

MISCELLANEOUS.

Science Examinations of the Committee of Council on Education.—The following are the results of the reports of the examiners on the examination which took place throughout the United Kingdom during the month of May last, comparing the numbers of candidates in 1864 with those of 1865. In geometrical drawing they have increased from 312 to 608; in machine drawing, from 185 to 293; in building construction, from 55 to 74; in mathematics, from 78 to 182; in theoretical mechanics, from 43 to 94; in applied mechanics, from 26 to 50; in magnetism and electricity, from 269 to 291; in inorganic chemistry, from 851 to 946; in geology, from 164 to 170; in animal physiology, from 479 to 548; in zoology, from 174 to 182; in vegetable physiology, from 121 to 229; in metallurgy, from 70 to 93; in navigation, from 99 to 103; in nautical astronomy from 70 to 82; in steam, from 63 to 76; and in physical geography, from 70 to 121. In five of the subjects there has been a slight decrease—viz., in acoustics, light, and heat, from 253 to 244; in organic chemistry, from 142 to 139; in mineralogy, from 28 to 19; in systematic botany, from 70 to 33; and in mining, from 22 to 15. The progression during the last five years has been as follows:—In 1861 there were 878 candidates; in 1862 there were 1943 candidates; in 1863, 2671 candidates; in 1864, 3644 candidates; and in 1865, 4593 candidates. The total number of prizes given in 1865 was 1482, against 1318 in 1864. The number of medals awarded in 1865 was as follows:—8 gold medals, 1 certificate instead of a gold medal, 17 silver medals, 6 certificates instead of silver medals, 22 bronze medals, and 12 certificates instead of bronze medals. The following were the successful candidates for the Royal Exhibitions awarded after the result of this examination:—For those at the Royal School of Mines, London—Thomas Jones, Woolwich; Edward Collens, Bristol; John A. Griffiths, Manchester. For those at the Government School of Science, Dublin—Frank Clowes, London; James Craik, London; John Conolly, Bandon; W. B. Leonard, Drogheda.

Fire-Damp in Coal Mines.—Mr. G. F. Ansell has sent to a contemporary the following account of his mode of applying the law of diffusion to the indication of the presence and amount of fire-damp:—"Gases would appear to be formed of minute atoms, which have motion amongst themselves, rapid or slow, in proportion to the density of the gas experimented upon. This motion of the atoms is not confined to each individual gas, but the atoms of one gas pass freely through and amongst the atoms of another gas, thus producing a perfect mixture of any two gases which are so circumstanced as to admit of the requisite motion. The atoms of a gas are not arrested in their motion by septa of porous substances—that is, substances impervious in the ordinary acceptation, but not absolutely so. Such substances include thin india-rubber, artificially prepared graphite, unglazed earthenware, &c. The law of diffusion, as educed by Mr. Thomas Graham, F.R.S., would appear to be as follows:—A gas diffuses into another gas or into space in the inverse ratio to the square root of its density. In the application of this law to the indication of the presence of fire-damp I follow my original thought, and use india-rubber. I fill a balloon of thin india-rubber (just such a balloon as that used by children for a plaything) with atmospheric air, and I place it under a lever. If now the apparatus be carried into a mine containing fire-damp, the fire-damp diffuses into the balloon, in accordance with the above law, quicker than the atmospheric air diffuses out from the balloon, and the result is that there is an increase of volume within the balloon, and this causes expansion, just as would occur if so much air were forced into it. I cause this increase of size to move a lever, and thereby to make a galvanic circuit, and so to telegraph to a distance, while it also rings a bell on the spot. This particular arrangement is intended to give warning of a slow accumulation of fire-damp, and in practice it answers perfectly, giving at each interval of an hour the increasing amount per cent. of fire-damp present at that part of the mine. Supposing the atmosphere, then, to remain without alteration the balloon remains of the same size, consequently the alarum would ring continuously for several days, but if the mine were purified, the balloon would shrink in consequence of diffusion, and the alarum would cease. If it be desired to give instant notice to the men at work, or to the people above ground, from the working place, I use a porous battery cell, which, with a small column of mercury, gives warning in a few seconds of sudden irruption of fire-damp. The action of this instrument is so immediate that, unless seen, it would appear to be incredible; it is, nevertheless, trustworthy and certain. Supposing the atmosphere which has caused the indication to remain unaltered, then the instrument empties itself by effusion, and the indicator returns to the original zero, and remains at that point until the mine is ventilated, when the indicator retires from zero, thus indicating the purification of the dangerous place. These remarks also apply to the pocket instrument described below. The instruments above spoken of are intended to give warning alone; but if it be desired for the information of viewers, inspectors, owners and others to ascertain the amount per cent. of fire-damp present in the air of mines, I vary the form of my apparatus, but the most convenient form is that which is assumed in the small aneroid barometer for the waistcoat pocket. The mercurial barometer, when fitted with the necessary accompaniments, gives very satisfactory results, as also does a column of mercury, not representing a barometer. As regards the aneroid barometer, I remove the brass back, and replace it by a piece of porous tile—the ordinary biscuit-ware of Wedgewood. In my first experiments I used a piece of a broken flower-pot, which gave as good results as could be wished for. The instrument so completed, with a few additional and purely mechanical arrangements, which I would describe were there space in this letter, may be used as an ordinary aneroid barometer, but at the time of using it, to tell the amount of fire-damp present, it is necessary to close a valve by a small screw. Then having read the point at which the barometer stands, and noting this as the zero, to remove a brass cap, which protects the porous tile; and if there be any fire-damp present the hand travels over the face of the dial, because the diffusion of the fire-damp into the chamber of the aneroid barometer causes an increased volume, which, being compelled to occupy a fixed space, causes pressure on the partly exhausted chamber within that space, and thus causes the hand to move over the face of the dial, indicating unfailingly the amount per cent. of explosive gas. In round numbers, 1 per cent. of gas is equal to ·01 inch, and 10 per cent. of gas to 0·10 inch on the aneroid barometer. The following results were obtained in the presence of experienced miners. I will, for this occasion, call my indicator an aneroid barometer:—Aneroid barometer indicated 1·50 per cent. of fire-damp; the Davy lamp gave no indication. Aneroid barometer indicated 3·00 per cent. of fire-damp; the gas could be detected by the Davy lamp, which gave a small pale blue flame. Aneroid barometer indicated 8·00 per cent. of fire-damp; the Davy lamp exploded feebly. Aneroid barometer indicated 10·00 per cent. of fire-damp; the Davy lamp exploded fiercely. Aneroid barometer indicated 6·00 per cent. of fire-damp; the Davy lamp did not explode, but flame elongated greatly."

Armenian or Diamond Cement.—This article, so much esteemed for uniting pieces of broken glass, for repairing precious stones, and for cementing them to watch-cases and other ornaments, is made by soaking isinglass in water until it becomes quite soft, and then mixing it with spirit in which a little gum mastic and ammoniacum have been dissolved. The jewellers of Turkey, who are mostly Armenians, have a singular method of ornamenting watch-cases, &c., with diamonds and other precious stones, by simply glueing or cementing them on. The stone is set in silver or gold, and the lower part of the metal made flat, or to correspond with the part to which it is to be fixed; it is then warmed gently, and has the glue applied, which is so very strong that the parts so cemented never separate. This glue, which will strongly unite bits of glass, and even polished steel, and may be applied to a variety of useful purposes, is thus made in Turkey:—Dissolve five or six bits of gum mastic, each the size of a large pea, in as much spirits of wine as will suffice to render it liquid; and in another vessel dissolve as much isinglass, previously a little softened in water (though none of the water must be used), in French brandy or good rum, as will make a two-ounce phial of very strong glue, adding two small bits of gum albanum, or ammoniacum, which must be rubbed or ground till they are dissolved. Then mix the whole with a sufficient heat. Keep the glue in a phial closely stopped, and when it is used set the phial in boiling water. Some persons have sold a composition under the name of Armenian cement in England; but this composition is badly made; it is much too thin, and the quantity of mastic is much too small. The following are good proportions: Isinglass, soaked in water and dissolved in spirit, two ounces (thick); dissolve in this ten grains of very pale gum ammoniac (in tears), by rubbing them together; then add six large tears of gum mastic, dissolved in the least possible quantity of rectified spirits. Isinglass, dissolved in proof spirit, as above, three ounces; bottoms of mastic varnish (thick but clear), one and a-half ounces; mix well. When carefully made, this cement resists moisture and dries colourless. As usually met with, it is not only of very bad quality, but sold at exorbitant prices.—*Tinman's Manual and Sci. Amer.*

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. *Private* letters for the Editor must be so marked.

We have received a note from Mr. Le Neve Foster, stating that there are no more copies of Dr. Hofmann's Exhibition Report for sale.

Quero.—Should read all the lectures attentively. The term was first used by Laurent, who distinguishes two kinds of compound bodies—*Aplones*, or simple combinations, and *Diameranes*, or complex or divisable combinations. See "Chemical Method" by Laurent, published by the Cavendish Society.

Books Received.—"A Dictionary of Chemistry, &c.," by A. Watts B.A., F.C.S.; Part XXXII., Phenylamines to Phosphorus.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Analysis of the New Phosphatic Rock Recently Discovered in Wales, by Dr. T. L. PHIPSON.

AN extensive deposit or lode of phosphatic material has lately been discovered in Wales, about sixteen miles from Oswestry, in the neighbourhood of Cwmgynen, by Mr. Hope Jones. Attention was called to this deposit by Professor Voeclker, in a paper read a few weeks ago to the British Association at Birmingham; but, unfortunately, the Professor gives no analysis of the rock in his otherwise interesting paper, contenting himself with reference only to the percentage of phosphate of lime yielded by certain isolated specimens.

To supply this want, I publish the following analyses of four different samples of the phosphatic rock, with the permission of Messrs. Griffin, Morris, and Griffin, the eminent agricultural chemists, of Wolverhampton, for whom the analyses were made.

The rock is massive, of a very dark olive colour, inclining to black, and yields a grey powder when pulverised. It resembles certain varieties of triplite or altered triphane. I have sought particularly in it for *lithia* and *vanadic acid*, of both of which I have found very minute quantities, scarcely worth alluding to in a practical point of view. In nature this phosphatic rock forms a wide perpendicular vein between clay-schist and pipe-clay, and in the neighbourhood of a dark bituminous limestone, which also contains a notable proportion of phosphoric acid. In the following analyses No. I. and No. II. were solid specimens, weighing several pounds, taken from different localities; No. III. was a pulverised specimen from another part of the mine, and No. IV. is a mean analysis of three other distinct specimens:—

	I.	II.
Water	8·00	3·00
Phosphate of iron	29·40	19·00
Phosphate of lime	13·00	50·00
Silicate of alumina	44·00	26·00
Carb. of iron, carb. of lime, and matters not determined	5·60	2·00
	100·00	100·00

	III.		IV.
Water	6·00		5·00
Phosphoric acid	27·00		14·60
Lime	21·91		17·35
Protoxide of iron	20·88		9·87
Silicate of alumina	22·00		38·60
Carbonic acid, &c.	2·19	Carb. of lime, &c.	14·50
	100·00		100·00

It will be seen by these analyses that the rock consists of phosphate of iron and phosphate of lime in very variable proportions. The analyses lead nearly to the following formula:—

No. I. . . . . $(2\dot{\mathrm{fe}}^3\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}} + \dot{\mathrm{C}}\mathrm{a}^3\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}})$

No. II.. . . . $(\dot{\mathrm{fe}}^3\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}} + 3\dot{\mathrm{C}}\mathrm{a}^3\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}})$

No. III. . . . $(\dot{\mathrm{fe}}^3\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}} + \dot{\mathrm{C}}\mathrm{a}^3\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}})$

No. IV. . . . $(\dot{\mathrm{fe}}^3\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}} + 2\dot{\mathrm{C}}\mathrm{a}^4\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}})$

The general formula of the rock must therefore be—

$$\begin{bmatrix}\dot{\mathrm{fe}}\\ \dot{\mathrm{C}}\mathrm{a}\end{bmatrix}^{3},\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}$$

In which $\dot{\mathrm{F}}\mathrm{e}$ and $\dot{\mathrm{C}}\mathrm{a}$ are substituted one for the other in various proportions. As it contains no oxide of manganese, it may be regarded as triplite in which the manganese is replaced entirely by lime, and the name *calc-triplite* proposed for it. The rock is mixed mechanically with pipeclay or aluminous schist (silicate of alumina) insoluble in hydrochloric acid. Some specimens contain a little carbonate of iron, and in No. IV. there is a good deal of carbonate of lime. I look upon the discovery of this new rock as likely to prove a valuable source of phosphoric acid in the arts, and trust that the dimensions of the lode are really as great as they have been represented; but I do not believe, as stated in *The Reader*, October 21, p. 464, that "the phosphatic mine is readily accessible and naturally drainable to a depth of about 500 miles."(!)

4, The Cedars, Putney, London, S.W.

On Boric Ethers, by MM. HUGO SCHIFF *and* E. BECHI.*

BY making different alcohols react on boric anhydride, Ebelmen obtained, in 1846, a series of ethers, the analysis of which led to the general formula—

$$\mathrm{B}_4\mathrm{Et}_2\Theta_7 (\mathrm{Et} = \text{alcoholic radical.})$$

In some researches on boric ethers we had occasion to repeat Ebelmen's experiments, and the results we obtained were different from his.

The primary action of liquid saturated alcohols, of the formula $Ȼn\mathrm{H}_{2}n+_{2}+\Theta$, on boric anhydride, is expressed by the equation—

$$\left.\begin{matrix}\mathrm{B}\\ \mathrm{B}\end{matrix}\right\}\Theta_3 + 3\left.\begin{matrix}\mathrm{Et}\\ \mathrm{H}\end{matrix}\right\}\Theta = \left.\begin{matrix}\mathrm{B}\\ \mathrm{Et}_3\end{matrix}\right\}\Theta_3 + \left.\begin{matrix}\mathrm{B}\\ \mathrm{H}_3\end{matrix}\right\}\Theta_3.$$

Trialcoholic borates, whose preparation by the methods of Ebelmen and Rose is difficult, may be obtained readily, and in large quantities, by causing an excess of alcohol to act on boric anhydride, in a digester at about 120°. We separate the boric ether from the unattacked alcohol by fractional distillation. On treating the different portions with concentrated sulphuric acid two layers are obtained, the upper one containing the ether mixed with a little alcohol and a trace of sulphuric acid.

Trialcoholic borates, heated with boric anhydride, combine directly with a molecule of the latter, forming mono-alcoholic borates—

$$\left.\begin{matrix}\mathrm{B}\\ \mathrm{Et}_3\end{matrix}\right\}\Theta_3 + \left.\begin{matrix}\mathrm{B}\\ \mathrm{B}\end{matrix}\right\}\Theta_3 = 3\left.\begin{matrix}\mathrm{B}\\ \mathrm{Et}\end{matrix}\right\}\Theta_2.$$

This transformation of trialcoholic ethers is complete. If, in the action of boric anhydride on alcohols, instead of an excess of alcohol, an excess of the anhydride be used, a mixture of alcohol and mono- and trialcoholic borates is obtained. In this case the alcohol and trialcoholic ether are removed by distillation, which is continued until the liquid has attained a temperature 20° or 30° above the boiling point of the trialcoholic ether. The residue consists of monoalcoholic borate, contaminated by boric acid; these are separated by means of anhydrous ether, which simply dissolves the boric ether. Alcohol will not serve for this purpose, because alcohols act energetically on monoalcoholic borates, transforming them into trialcoholic borates. By treating monoalcoholic borates by alcohols homologous to those which contributed to the formation of these borates, we prepared mixed methyl-ethylic and ethyl-amylic boric ethers.

Monoalcoholic borates are dense liquids, which cannot be distilled. Submitted to a high temperature, they split

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* *Comptes Rendus*, lxi., 697.

into trialcoholic borate, and monoalcoholic triborate, according to the equation—

$$4\left.\begin{matrix}\mathrm{Et}\\ \mathrm{B}\end{matrix}\right\}\Theta_2 = \left.\begin{matrix}\mathrm{B}\\ \mathrm{Et}_3\end{matrix}\right\}\Theta_3 + \left.\begin{matrix}\mathrm{B}_3\\ \mathrm{Et}\end{matrix}\right\}\Theta_5.$$

To effect a complete splitting up requires a temperatnre of from 250 to 290° for the methylic and ethylic compounds. Ebelmen, who heated only to 200°, analysed mixtures of monoalcoholic borates and triborates.

The triborates are vitreous substances, which decompose at a very high temperature, leaving boric anhydride. With alcohols they furnish trialcoholic and mixed ethers.

Unsaturated boric ethers combine neither with oxide of ethyle nor with hydriodic ethers. The latter reaction should produce boric ethylhydrines, substances which seem to be formed by the not very energetic action of fluoride and chloride of boron on trialcoholic ethers.

The data given in this note apply only to methylic, ethylic, and amylic alcohols. In a future communication we hope to give the results of our researches on boric ethers derived from alcohols belonging to other series.

On the Use of Bisulphate of Soda as a Substitute for the Bisulphate of Potash in the Decomposition of Minerals, especially the Aluminous Minerals, by J. Lawrence Smith, *Professor of Chem., University of Louisville.*

In referring to the more recent works on analytical chemistry, I perceive that the bisulphate of potash is still used to the almost utter exclusion of bisulphate of soda in rendering certain minerals soluble; and it is still recommended as the proper agent to fuse with aluminous minerals, as corundum, emery, &c.

This subject occupied my attention to a considerable extent when engaged in the preparation of two memoirs on the geology and mineralogy of emery presented to the French Academy of Sciences in 1850,* as well as in some investigations I am now making on the emery from Chester, Mass. In the above researches I had a large number of corundums and emeries to analyse. The powdered minerals were fused with the bisulphate of potash in the usual way, and I found no difficulty in decomposing the minerals; but unfortunately during the operation a double salt of potash and alumina is formed which is almost insoluble in water or in the acids; and it is only by a solution of potash that it is first decomposed and afterwards redissolved. There are many disadvantages and delays attendant upon this method, which experience soon exhibits—as the constant deposition of alum if the solution is not kept quite dilute. I therefore experimented with the bisulphate of soda, knowing that the double salt of alumina and soda was quite soluble, and my results were everything that could be desired; for while the soda salt gives a decomposition at least as complete as the potash salt, the melted mass is very soluble in water, and in the future operations of the analyses there is no embarrassment from a deposit of alum. The manner of employing the bisulphate of soda in the analysis of emery will be referred to in a future article on the emery of Chester, Mass.

Preparation of the Bisulphate of Soda.—The ordinary commercial article is not sufficiently pure for use, and I prepare it from pure carbonate of soda or sulphate of soda that has been purified by recrystallisation. In either instance pure sulphuric acid is added in excess to the salt in a large platinum capsule, and heated over a flame until the melted mass, when taken up on the end of a glass rod, solidifies quite firmly. The mass is then allowed to cool; moving it over the sides of the capsule will facilitate this operation. When cool it is readily detached from the capsule, is then broken up and put into a glass stoppered bottle. So far as my experience has yet gone, in almost every instance where we have been in the habit of using bisulphate of potash the bisulphate of soda can be substituted.—*American Journal of Science and Arts.*

On Some New Derivatives of Indigotine, by M. P. Schutzenberger.†

Isatine is derived from indigotine by means of oxidation. Its molecule contains one atom of oxygen more than the latter body:—

$$\underbrace{\mathrm{C}_8\mathrm{H}_5\mathrm{N}\Theta + \mathrm{O}}_{\text{Indigotine.}} = \underbrace{\mathrm{C}_8\mathrm{H}_5\mathrm{N}\Theta_2.}_{\text{Isatine.}}$$

Under the influence of nascent hydrogen, obtained by the mixture of zinc and hydrochloric acid, isatine is changed to isathyde, and the hydrogen becomes fixed:—

$$\underbrace{2(\mathrm{C}_8\mathrm{H}_5\mathrm{N}\Theta_2) + \mathrm{H}_2}_{\text{Isatine.}} = \underbrace{\mathrm{C}_{16}\mathrm{H}_{12}\mathrm{N}_2\Theta_4.}_{\text{Isathyde.}}$$

I supposed that by submitting isatine to the action of a more energetic reducer, such as a solution of hydriodic acid, at above 100°, the reduction would be more complete and the indigotine regenerated.

This did not happen, but some reactions took place at from 130° to 140°, which furnished the new compounds forming the subject of this memoir.

I heated pure isatine at 140° in a closed vessel with a solution of hydriodic acid of 45° Baumé. A large quantity of iodine separated itself, with the formation first of isathyde, then of a dark green amorphous mass, insoluble in water.

This product, washed with sulphurous acid to eliminate all the iodine, and then in pure water, is a mixture of three new bodies capable of being separated by alcohol and ether. Boiling alcohol removes a slightly soluble white substance; then a violet-red matter almost insoluble, and which can be completely dissolved only by repeated exhaustion.

There remains a considerable residue of a green matter, insoluble in all neutral solvents. The alcoholic solutions, being concentrated, may be precipitated by water. The dried precipitate yields a red body to ether, while the white body refuses to dissolve in this menstruum.

The white matter may be purified by crystallisation in alcohol or in concentrated acetic acid, when it is deposited in the form of microscopic needles.

The red matter obtained by evaporating the etherial liquid may be freed from the small quantity of the white body accompanying it by washing it in hot caustic soda and then dissolving in crystallisable and boiling acetic acid. On cooling it separates in the form of fine dark red needles.

The latter body is allied to indine, which M. Laurent obtained by the action of caustic soda on sulphuretted isathyde, but is distinguished from it by its composition and by certain differences in its properties.

The composition of these three new derivatives was determined by the following analyses:—

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* See *American Journal of Arts and Sciences,* vol. x., 1850, and vol. xi., 1851.

† *Comptes Rendus,* lxi. 284.

1. A green matter dried at 120° :—

	1st product.		2nd product.	3rd product.	
	I.	II.	III.	IV.	V.
Carbon .	70·11	70·27	71·10	70·25	69·74
Hydrogen .	4·36	4·51	4·41	4·68	4·37

Hence the formula :—

$$Ꞓ_{32}H_{24}N_4Ɵ_5 = \underbrace{4(Ꞓ_8H_5NƟ_2)}_{\text{Isatine.}} + 4H - 3Ɵ.$$

Theory.

Carbon	70·58
Hydrogen	4·41

2. White matter dried at 120° :—

	I.	II.	III.
Carbon . .	74·57	74·76	,,
Hydrogen .	4·59	4·57	4·53

From which is deduced the formula :—

$$Ꞓ_{32}H_{24}N_4Ɵ_3 = 4(Ꞓ_8H_5NO_2) + 4H - 5Ɵ.$$

Theory.

Carbon	75·00
Hydrogen	4·65

3. Matter dried at 120° :—

	1st matter.		2nd and purer matter.
	I.	II.	III.
Carbon . .	73·31	73·34	75·04
Hydrogen .	5·83	5·68	5·59

Hence the formula :—

$$Ꞓ_{35}H_{28}N_4Ɵ_3 = 4(Ꞓ_8H_5NƟ_2) + 8H - 5Ɵ.$$

Theory.

Carbon	74·41
Hydrogen	5·42

Both the red and the green matter fix hydrogen under the influence of alkaline reducers, and change into white or yellow bodies, capable of reproducing by oxidation the primitive compounds.

For these bodies I propose the following names :—

1. Green matter, isatochlorine.
2. Red matter, isatopurpurine.
3. White matter, isatone.

They have some analogy with the products prepared by M. Laurent by treating sulphuretted isathyde with soda, but are easily distinguished from them. The results obtained by analysis are very different, and the characteristics do not agree on many points.

TECHNICAL CHEMISTRY.

The Past and Present History of Alum, by J. Carter Bell, *Esq., F.C.S., Associate of the Royal School of Mines, London.*

In reviewing the various departments of manufacturing chemistry we are sensibly struck by the great improvements made in the different branches within the last few years, and the great advantages which have accrued from them; for in many instances the price of the chemical products has been reduced to one-half and even one-fourth what it originally was, owing greatly to the large amount of skill which is brought to bear upon the subjects in question. The past and present history of alum offers a very good example of the strides which manufacturing chemistry has made. The discovery or invention of alum seems to be quite lost; where it was first made or discovered is difficult to say, for the ancients seem to have confounded many salts under the name of alum. At the present day the word alum is applied to a number of double salts, such as the iron, chrome, soda, potash, and ammonia alums. Though all these may be composed of different elements, yet they are arranged in the same manner, and may be expressed by a general formula—

$$MORO_3 + M_2O_3 3RO_3 + 24aq.$$

The alums spoken of here refer to the ammonia and the potash salts. What the Romans called "alumen" was only the green sulphate of iron. But alum must have been very early known, for Herodotus, who lived 460 years before the Christian era, mentions Egyptian alum, and says that the King of Egypt sent a thousand talents to the people of Delphos on the destruction of their temple by fire; but, according to Beckmann, the Greeks and the Romans speak of nothing but natural alum; and several of our most acute mineralogists (mentioning Scopoli and Sage) deny the existence of native alum. There must be some mistake on this point, for several alums are found native. In the first place, there is the potash alum, found in the Lipari Islands, Sicily, St. Michael, Norway, and even in Yorkshire. The soda alum is found in the Neapolitan Solfatara, Island of Milo, and Mardoza. The ammonia alum at Thuringia, Bohemia. If all these alums are found now, there is no reason to suppose they were not found then; on the other hand, there is every reason to suppose they were acquainted with alum and its uses; for if we look at the skill they possessed in the art of dying, such as their Tyrian purple, etc., one can readily believe that alum was well known to them, and that they found it in its natural state; for even Pliny seems to have been acquainted with it, for he says one kind was white, and used for dyeing wools of a bright colour. In Pliny's time the Egyptian alum was considered the best, and, according to Beckmann, it still forms one of the exports of Egypt; "but," he says, "I am acquainted with no author who mentions the place where it is found or made, and as the smallest trace of alum works is not to be found amongst the ancients, the only conclusion is that they must have found the natural alum or some other salt to which they gave that name."

We now come to the history of our present alum. It was first made in the East. Beckmann says the invention is later than the twelfth century; but this cannot be correct, for Geber, the Arab physician, who lived about the eighth century, mentions it, and describes the method of making burnt alum. It seems that the Italians procured their alum from the Levant; but when these countries were in possession of the Turks, the people who denominated themselves Christians did not like purchasing of the infidels, and in the course of time they learned to make their own alum: then the chief manufactory of this important salt belonged to the Papal States, and the works which are near Civita Vecchia are considered by some to have been the first of any importance. The founder of them was John di Castro. He acquainted Pope Pius II. of the place where the aluminous material might be found. These works succeeding beyond their expectations, the Pope thought Castro worthy of high honours, and a statue was erected to him in his own country, with this inscription—"To John di Castro, the inventor of alum." When the alum works of the Papal States were found to be successful, others were erected in various parts of the Continent. The first works which were erected in England were at Gisborough, in Yorkshire, in the reign of Queen Elizabeth. The manufactory belonged to Sir Thomas Chaloner. He was obliged to engage privately some of the Pope's workmen, as there was nobody who understood the process in this country. But when the Pope heard of this, he cursed them by candle, by bell, and by book; but, as in the "Jackdaw of Rheims"—

> "What gave rise to no little surprise,
> Nobody seemed one penny the worse."

(The curse may be read in full in the "Life and Adventures of Tristram Shandy"), for very soon the works succeeded so well that several more were established. These works at Gisborough are, I believe, still carried on. According to Ure, the manufacture of this salt was begun at Harlet, in Scotland, by Nicholson and Lightbody in 1766; abandoned, and resumed by Macintosh and Wilson in 1797.

The old method of manufacture, such as is carried on at Hurlet and Whitby, is to roast the shale, lixiviate with water, evaporate the lixivium, and then precipitate the alum by alkaline salt, then wash the alum flour, then crystallise. First, as to the preparation of the alum shale. Some of these shales, when piled in the open air, get spontaneously hot from the oxidation of the iron pyrites into sulphate of iron; and as the process goes on the sulphuric acid is transferred to the alumina with the formation of sulphate of alumina. These heaps soon fall into a porous mass; when they can be readily lixiviated. Those shales which contain too little carbonaceous matter to carry on the combustion must have this added as the piling goes on. At Whitby they use brushwood, and at Harlet small coal for the lower bed, and then the piling of the shale commences. When they have got to the height of three or four feet the mass is kindled, and more shale is piled up. At Whitby this piling process goes on till the heap is 90 or 100 feet high. The horizontal area is also augumented till it forms a bed nearly 200 feet square, having, therefore, about 100,000 yards of solid measurement. At Harlet the height of the heap is only a few feet while the horizontal area is expanded. At Whitby 130 tons of calcined schist produce one ton of alum (Ure). Great care is required in the calcining of these heaps, so as not to lose too much sulphur and sulphuric acid. Rather a slow, continual fire is the best; for if the heat rises too high then a kind of slag may be formed. When this process is over the heap is very much diminished in size.

The second process is the lixiviation. The calcined schist is put into cisterns, having the large pieces at the bottom. Water is run over it, and allowed to rest some time; it is then drawn off into another cistern, fresh water is put upon the schist—which, being weak, is run into a separate tank—and sometimes the ore is treated with a third addition of water and the exhausted ore is removed from the cisterns and piled in a heap, and sometimes calcined again, for it even now contains a large percentage of alumina—as much as 12 per cent.

The third process is the evaporation of these washings, and this is done by what is called a surface fire, because there is so much sediment deposited. The operation is conducted in a large stone cistern about six feet wide, three feet deep, and forty long, and covered by an arch of stone or brickwork. At one end is the firegrate, at the other the chimney; the cistern is filled, and the flame plays along the surface. As the concentration goes on more of the lixivium is run in till the whole gets of the proper strength, when it is transferred to the leaden boilers. These lead pans are about eight feet long, nearly five feet wide, and two deep at one end, and a little more than two and a-half at the other; the increase of depth is to facilitate the syphoning off. In these lead pans the liquid is boiled; every morning the pans are emptied into a settling cistern of stone or lead.

The fourth process is the precipitation of the alum by adding alkaline salts. The clear liquor is run off into the precipitating cistern, and the potash or ammonia salts are added to it; the alum is precipitated in a granular powder. When it is thoroughly settled and cool, the mother liquor is drawn off into a lower cistern.

The fifth operation is the washing of the alum flour, because it has a brown colour, from admixture of iron compounds. This is done by means of very cold water, and after the second washing the alum is pretty pure, and this flour is sometimes sent into the market because it dissolves easily.

The sixth and last process is the crystallisation. The washed crystals are dissolved in water at a boiling heat. When the liquid is saturated, it is run into the crystallisation vessels or roaching casks; at the end of eight or ten days the alum is broken up and dried, and is then ready for the market. This process of making alum is certainly very rude, and is also attended by great waste of time and labour. This mode of manufacture will very likely disappear altogether, because of the improved methods Mr. Spence, of Manchester, has brought out. He has, indeed, quite revolutionised the alum trade; but any one reading the article on alum in Dr. Muspratt's "Dictionary of Chemistry" would think that the new process was not at all different from the old. Dr. Muspratt gives Mr. Spence's process in the following words:

"Spence, who lately sealed a patent for the manufacture of alum, offers the following as his method of calcination:—He forms on the ground a number of air channels, by laying parallel lines of common brick at the distance of four inches apart, and placing others on them crosswise; thus the channel formed is about four inches square. The transverse bricks are placed on loosely, so as to allow the air to pass freely upwards, burning coals are laid on the channels, and a layer of the shale, which is most bituminous, broken into small pieces, and as the combustion proceeds, other layers of the shale fragments, less bituminous than the preceding, are put on continuously, but not in too great a quantity. The thickness of each layer should be regulated by the briskness of the combustion, which should never go beyond a low red heat, but care must be exercised in maintaining the bed at this point, as a higher temperature would be apt to glaze or partially flux the materials, and render the alumina less soluble in acid. An examination of the following figure, exhibiting the heaps or mounds in various stages of progress, will show that a similar method to this is practised at Hurlet."

This is a most unfair description of such important alum works as Mr. Spence's are, and I am surprised to find such a statement in such a compendious dictionary as Dr. Muspratt's professes to be; in such a book as the one mentioned, one looks to find all the newest improvements, and not so much about operations practised a century ago. Mr. Spence's process is totally different from the old, as any one reading the following will see:—By the old process the manufacturer would have to wait about twelve months or more before he would have any alum ready for the market; by the new it would only be about one month. Mr. Spence has now become one of the largest manufacturers in the world, producing nearly 150 tons a week. It is to be hoped that in the next edition of the dictionary a better description will be given.

(To be continued.)

To Thaw out Frozen Pumps.—A pint of salt has been found generally sufficient. Two pints have been found enough to thaw through three feet deep. An hour's time suffices in ordinary cases.—*Vermont Phœnix.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, November 2.

Professor W. A. Miller, *M.D., F.R.S., President, in the Chair.*

After the minutes had been read, Mr. W. Tilden, of the Pharmaceutical Society's Laboratory, was formally admitted a Fellow of the Society; and Mr. James Parkinson, Royal School of Mines, and Mr. Frederic Rowe, Colchester, were balloted for and duly elected as Fellows. The names of Mr. William Marriott, Huddersfield, and Mr. Charles Umney, 40, Aldersgate Street, London, were read for the second time, and several new candidates were proposed, whose names were read as under:—John Hunter, M.A., Queen's College, Belfast; Mr. Theodore Maxwell; Mr. William Jacob Barnes, Starling Lodge, Buckhurst Hill, Essex; Mr. W. E. Bickerdike, Dalton Square, Lancaster; Mr. Richard Fitz'Hugh, Nottingham; Dr. William B. Ritchie, Belfast; and Mr. Alfred Gardiner Brown, Member of the Royal College of Surgeons, Trinity Square, Southwark.

The list of donations to the Society's library was unusually long, and the President announced that at the next meeting of the Society, before commencing the ordinary business, the members would resolve themselves into a Committee "to consider the best means of disposing of several chemical specimens in the Society's possession." He had great pleasure in calling attention to the admirable arrangements made for the ventilation of the meeting-room, which had been jointly undertaken by Dr. De la Rue and Dr. Matthiessen. [These consisted of a spacious perforated grating near the ceiling, which communicated with an air-shaft, in which a series of gas jets, circular in form, were burning. There were also numerous small apertures on either side of the room for the admission of fresh air, opening beneath the platform upon which the seats are placed. The efficacy of the ventilator was apparent throughout the evening; but at the close of the proceedings Dr. De la Rue fired a small portion of gunpowder to show how rapidly the smoke made its escape. A handsome cornice and spring roller, from which diagrams may be suspended, have been placed in front of the grating, the aperture of which can be regulated at will by a sliding shutter.]

Professor A. H. Church was then invited to give an account of his "*Chemical Researches on some New Cornish Minerals.*" The speaker stated that in July last he visited Cornwall and collected some fifty or sixty mineral specimens, which included many interesting varieties of well-known species. In seven instances he was induced to make complete analytical examinations, and by the results was led to the conclusion that three of the minerals had not previously been described; these were:—

I. Hydrated phosphate of cerium.
II. Hydrated phosphate of calcium and aluminium.
III. Hydrated arseniate of copper and lead.

With respect to the first of these minerals, Mr. Church said he believed there was no instance on record of cerium having been previously discovered in Great Britain. He was indebted for the specimen to Mr. Richard Talling, of Lostwithiel, and at first it was believed to be a kind of Wavellite, but the precipitate furnished by ammonia in the course of analysis became reddish-brown upon ignition, and gave off chlorine during subsequent solution in hydrochloric acid. These characters seemed to indicate the presence of oxide of cerium, which was confirmed by the slightly pinkish hue of the precipitate thrown down by oxalate of ammonia, by the blowpipe reactions, and, finally, by the formation of very definite crystals of the double sulphate of cerium and potassium. The mineral was found to contain upwards of 50 per cent. of cerous oxide, about 5 per cent. of lime, and 28 of phosphoric acid, with about 15 per cent. of water. Its mineralogical formula would, therefore, be expressed thus:

$$(\dot{\mathrm{Ce}}_{\frac{5}{6}}\dot{\mathrm{Ca}}_{\frac{1}{6}})_3\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}+4\dot{\mathrm{H}},$$

which is equivalent, under the new atomic system, to

$$5\mathrm{Ce''O,Ca''O,2P_2O_5+8H_2O}.$$

The colour of the mineral was a pale smoke grey, with a slight inclination to flesh-red, and its general aspect is slightly pearly. The crystals, as defined by Professor W. H. Miller, are doubly refractive and of the oblique prismatic system, and they commonly occur in fan-like aggregations. The hardness and density of the mineral are both expressed approximatively by the figure 3. The small quantity of the sample placed at the author's disposal prevented his making any reliable examination for fluorine, and the quartz matrix added to the difficulty. The mineral most nearly allied to that now described is cryptolite—a phosphate of cerium containing neither calcium nor water.

The *hydrated phosphate of calcium and aluminium*, although classed among the minerals from Cornwall came from the borders of that county, and occurred in a copper lode at Tavistock, South Devon. It is a white, silky, fibrous mineral, somewhat difficultly soluble in acids. Although very different in physical appearance, it seems to be identical with the rounded pebbles found in the diamond sands of Bahia, and described by M. Damour in 1853. Its mineralogical formula is,—

$$\dot{\mathrm{Ca}}_3\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}+\overset{\cdot\cdot\cdot}{\bar{\mathrm{A}}\mathrm{l}}\ 3\dot{\mathrm{H}}$$

and corresponding chemical expression (new system),—

$$3\mathrm{Ca''O,P_2O_5,Al_2'''O_3+3H_2O}.$$

The third mineral which had been submitted to analysis by Professor Church was a variety of Olivenite or arseniate of copper, but differed from it both in colour and density, and was found to contain as much as 30 per cent. of plumbic oxide. Its specific gravity was 5·35; colour, sap green, and lustre resinous. The specimen contained but a small proportion of phosphoric acid, and proved to be a hydrated arseniate of copper and lead, for which the author proposed the formula,—

$$\mathrm{Pb''O.2Cu''O,As_2O_5+Cu''H_2O_2+aq.}$$

The author proposed to confer upon this new mineral the name of Bayldonite.

The President, in moving a vote of thanks to Professor Church, inquired whether other metals of the cerium group, particularly didymium, had been found in the new mineral phosphate of British origin?

Professor Church answered in the affirmative, an examination of an optical character having been made by Mr. C. Greville Williams, who distinctly identified the didymium bands.

[*Vide* Chemical News, p., 183 of this volume.]

Professor Maskelyne said that great credit was due to Mr. Church for the successful manner in which he had worked out the composition from so small a quantity of material. He had himself received two specimens of the cerium mineral from Mr. Talling (who was a most indefatigable collector), and had measured the angles as long since as two years ago; he had likewise identified the phosphoric acid. For the rest, he might almost say that he envied Mr. Church his means of research, for he had applied to the authorities of the British Museum for a chemical laboratory in which to make such analytical examinations as the present, but they were opposed to carrying out his suggestion. He had brought with him the two specimens for comparison with that which had been shown by Professor Church, and he had no doubt they were the same thing. After the publication of the analytical details, he hoped to do a little more with the goniometer, but already he was satisfied of their being square prisms. The mineral monazite was likewise a phosphate of cerium containing thorium and about 2 per cent. of lime, and it would be interesting to know whether this rare earth occurred in the Cornish specimen. The speaker had compared and measured at least twenty mineral specimens which might be included under the group Olivenite, and found many that would repay a chemical examination. He regretted that he had no means of undertaking this. Professor Maskelyne concluded by pronouncing a tribute of praise to Richard Talling, of Lostwithiel, who had done so much for mineralogy by his successful search after new minerals.

Professor Church described the steps taken in testing for thoria, and believed it was absent, since the whole of the earth in the Cornish mineral was precipitated by excess of ammonia, which is not the case with thoria. Besides, he obtained 100 parts by adding together the weights of the several constituents. He would be happy to lend his specimen to Professor Maskelyne for determination of its crystallographic characters.

A paper "*On Caprylic and Œnanthylic Alcohols*," by Mr. Ernest T. Chapman, was read by the Secretary. The author referred to the uncertainty respecting the exact nature of the products obtained on distilling castor-oil soap with an excess of alkali, and proposed to address himself to the determination of the composition of a liquid boiling at about 178° C., in regard to the homogeneity of which there was a doubt. As the general result of the author's investigation, it may be stated that the composition of the distillate is by no means constant, and that both caprylic and œnanthylic alcohols in varying proportions are formed under these circumstances. Several analyses gave numbers closely according with $C_8H_{18}O$, and the production of caprylic alcohol was further proved by the formation from it of tri-caprylamine. Mr. Chapman incidentally prepared caprylic ether by the action of bromide of capryl upon potasso-caprylic alcohol.

Dr. Odling remarked that castor-oil itself was not likely to be a definite substance, and might yield products of one or other series, or a mixture, according to the quality of the sample employed.

The Secretary exhibited a piece of sheet copper, very much corroded, which was sent from Nova Scotia by Professor How, and which, being a portion of a metal chimney, showed the result of eighteen years' exposure to the products of combustion of wood and coal.

The third paper read was entitled "*On the Absorption of Vapours by Charcoal*," by John Hunter, M.A. It was devoted to the examination of the powers of absorption of different kinds of charcoal, and the author found that the dense carbon obtained from the shell of the cocoa-nut was pre-eminently endowed with this property, and with it several comparative trials were made under varying degrees of temperature. The saturation point of the carbon was found to be in every case diminished by increase of temperature, and of all the vapours examined that of methylic alcohol was the most freely absorbed, for no less than 155 volumes of that vapour at the temperature of 90° C. were condensed by one volume of cocoa-nut charcoal. The experiments comprehended the trial of the following vapours:—Water, bisulphide of carbon, alcohol, methylic alcohol, fousel oil, benzol, ether, chloroform, and acetic acid; and the author noticed that the absorption of vapour by charcoal always terminated in a much shorter time than in the case of the permanent gases, rarely, if ever, exceeding an hour in duration.

Upon the invitation of the President, Dr. Stenhouse said that he had paid attention to the practical use of charcoal as a means of purifying air, and had always found the dense varieties of charcoal to be the most effective on account of the smaller size of their cavities. He had never made exact experiments of the nature just now described by Mr. Hunter.

The President then adjourned the meeting until Thursday evening, November 16.

COLLEGE OF PHYSICIANS.

"*On Animal Chemistry.*" A course of Six Lectures by William Odling, M.B., F.R.S., F.R.C.P.

Friday, May 12, 1865.

Lecture 6.

(Continued from page 201.)

I can scarcely venture to conclude this course of lectures on "Animal Chemistry" without a few words upon the influence exerted on tissue metamorphosis by those chemical agents which are usually included in the class of alterative medicines. Although our acknowledged ignorance of the mode in which medicines produce their effects is made a standing reproach to medical art only by those who, ignorant of their ignorance, wrongly conceive that in other scientific arts—that of the chemist, for example—the use of the different agents employed has really ceased to be empiric, and become dependent upon abstract principles, still it will not do for us to regard the observed actions of different medicines as ultimate facts with which we must ever rest contented, but rather as difficult problems inviting a more competent investigation, and destined some day or other to yield to our inquiries. The subject, however, is too remote from even the present widely-extended boundary of scientific knowledge—the path from the known to the unknown is yet too lengthy and intricate—to warrant us in expecting any immediate or, indeed, proximate resolution of the darkness by which we are surrounded. In the belief, however, that even a little gleam of light, insignificant in relation to more advanced researches, may not prove altogether worthless here, I beg to suggest the following points for your consideration. It will be found, I think, that those mineral substances which act more especially as alteratives actually are, and necessarily ought to be, characterised, not by their chemical energy, but by their chemical mobility; and I do not know that I can make my meaning better evident than by directing your attention to the chemical properties of iodine in comparison with those of its intimate congener, chlorine. As I shall presently show you, both elements possess in a striking degree the property of oxidising various substances which resist the action of ordinary oxygen; and this observation leads me to make a few preliminary remarks upon the process of oxidation in general.

Thus, it is well known that many oxidisable bodies which are unable or scarcely able to combine directly with free oxygen, can nevertheless combine on the instant with oxygen that is already in a state of combination. It seems, indeed, as if the fact of previous combination conferred upon the transferable oxygen a greater activity or tendency to unite with other bodies. Of this peculiarity of behaviour, the non-oxidation or slow oxidation of sulphurous acid H_2SO_3, into sulphuric acid H_2SO_4, by mere exposure to oxygen or air, and its rapid oxidation by means of certain hyperoxygenised compounds, such as the peroxides of hydrogen and nitrogen, affords us an excellent illustration. I have here a freshly-made solution of sulphurous acid, and to it I add a little chloride of barium, which, you observe, does not in the least disturb its transparency, thereby showing its freedom from any trace of sulphuric acid. I now draw a rapid current of air through the mixed liquid, but with no obvious effect. The sulphurous acid and oxygen, despite their agitation together, remain sulphurous acid and oxygen, instead of combining with one another to form sulphuric acid. Accordingly, we have not a trace of sulphuric acid produced sufficient to afford even a turbidity with the previously added barium-salt, although, indeed, by a prolonged agitation with one another, some sulphuric acid would be slowly formed. I now divide the mixed solution of sulphurous acid and chloride of barium, and add to one portion a little peroxide of hydrogen, when immediately we get a copious white precipitate of sulphate of barium. The sulphurous acid which would not unite with the free oxygen of the air unites at once with the combined oxygen of the peroxide, thus:—

$$\overset{\text{Sulphurous.}}{H_2SO_3} \quad \overset{\text{Hydric-perox.}}{H_2O.O} = \overset{\text{Sulphuric.}}{H_2SO_4} + \overset{\text{Water.}}{H_2O.}$$

The second half of the liquid I now pour into this bottle, charged, as you see, with brown fumes of peroxide of nitrogen, and agitate the whole for an instant or so, when the rapid oxidation of the sulphurous acid is rendered evident, in this as in the former experiment, by an abundant precipitation of sulphate of barium, while the brown peroxide is simultaneously reduced to the state of colourless oxide of nitrogen, thus:—

$$\overset{\text{Sulphurous.}}{H_2SO_3} + \overset{\text{Nitric perox.}}{NO.O} = \overset{\text{Sulphuric.}}{H_2SO_4} + \overset{\text{Nitric oxide.}}{NO.}$$

The peroxides of hydrogen and nitrogen, therefore, act upon sulphurous acid in a precisely similar manner; but we shall find a great difference of behaviour in the monoxides resulting from their respective deoxidations. Thus, the oxide of hydrogen or water is a far more difficult substance to peroxidise than sulphurous acid itself. It is only, indeed, by a series of indirect processes that we are able to fasten on to its molecule an additional atom of oxygen, so as to convert it into the peroxide, and this added atom of oxygen is retained with such a feeble force that it is frequently thrown off in the free state, and constantly given up with the greatest readiness to any oxidisable substance, such as sulphurous acid. Although, therefore, it seems strange that sulphurous acid should not readily absorb oxygen from the air, there is nothing strange in its taking away the additional loosely combined oxygen existing in peroxide of hydrogen. But the oxide of nitrogen resulting from the deoxidation of *its* peroxide is a very different kind of body. Of all compounds known to chemists it is the one which absorbs free oxygen with the greatest avidity. No sooner, for instance, do I open the stopper of this bottle than the contained nitric oxide which we reduced from the peroxide a few minutes ago combines at once with fresh oxygen from the air to become reconverted into the brown peroxide; and on now closing the bottle and agitating its contents, the sulphurous acid, which is of itself unable to combine directly with atmospheric oxygen, instantly robs the peroxide of nitrogen of the oxygen which it had absorbed directly from the atmosphere, as in the ordinary manufacture of sulphuric acid; thus:—

$$\overset{\text{Sulphurous.}}{HSO_3} + \overset{\text{Oxygen.}}{O} = \overset{\text{Sulphurous.}}{H_2SO_3} + \overset{\text{Oxygen.}}{O.}$$

$$\overset{\text{Nitric oxide.}}{NO} + \overset{\text{Oxygen.}}{O} = \overset{\text{Nitric peroxide.}}{NO_2.}$$

$$\overset{\text{Sulphurous.}}{H_2SO_3} + \overset{\text{Nitric perox.}}{NO_2} = \overset{\text{Sulphuric.}}{H_2SO_4} + \overset{\text{Nitric oxide.}}{NO.}$$

As remarked by Laurent, "There is no substance which presents such singular properties as nitric oxide. . . . It is, perhaps, the only body which, in the dry state and at the ordinary temperature, can combine suddenly with oxygen. The combination, moreover, takes place without the evolution of heat, and the body which results, far from retaining the oxygen that it has so readily absorbed, is perhaps of all bodies the one which is deoxidised most easily." Nitric oxide and peroxide, then, are the types of chemically mobile compounds. Regarded as a reducing agent, there are many more powerful deoxygenants than the oxide, regarded as an oxidising agent, there are many more energetic oxygenants than the peroxide, but there are no two associated bodies known to chemists which respectively absorb or evolve oxygen with so much facility. Now, while chlorine may be compared to peroxide of hydrogen, it is the sort of chemical mobility manifested by the oxides of nitrogen, which is characteristic of iodine, and, I believe, of most mineral alteratives. Iodide of hydrogen or potassium is, like nitric oxide, a facile reducing agent, and free iodine or hypoidite of potassium, like peroxide of nitrogen, a facile oxygenant—so that wherever the iodine travels it is capable of influencing the processes of oxidation there going on—absorbing oxygen where there is excess, delivering active oxygen where there is deficiency—just as our nitric compound absorbs oxygen from the air and delivers it up to the sulphurous acid.

It is this mobility of iodine, then, which distinguishes it chemically from its more active congeners, chlorine and bromine. The general chemical relationship of these three elements to one another is most striking, so much so, indeed, that they might almost be regarded as mere varieties of the same primitive matter. With the probable exception of fluorine, they are the only elements which have the property of uniting with hydrogen in the proportion of volume to volume,—the combinations, moreover, being unattended by any condensation. Again, the resulting compounds—namely, the hydrochloric, hydrobromic, and hydroiodic acids are all gaseous, all fuming, all soluble in water, and all producible by similar reactions. Another common property by which chlorine, bromine, and iodine are characterised is their marked activity when in the free state, which very greatly exceeds that of oxygen under similar conditions. In my last lecture I showed you the violent action of chlorine on metallic copper, upon which ordinary oxygen is, as you know, almost without action; and I have only a few minutes back referred to the little effect exerted by free oxygen upon various oxidisable bodies. But chlorine, bromine, and iodine act upon different metals, pseudo-metals, and compounds with the greatest facility; and, indeed, several of the iodides contained in the London and British Pharmacopœias are directed to be made by treating the respective metals with iodine. Lastly, all three elements are capable of acting as oxidising agents in cases where free oxygen is altogether, or almost, impotent. They contain no oxygen, it is true, and are, on the contrary, so far as our present knowledge goes, simple or elementary bodies. Nevertheless, in the presence of water they act as very powerful oxygenants by uniting with the hydrogen of the water, and so liberating its pre-combined and, consequently, active oxygen. Thus, on adding chlorine, bromine, and iodine respectively to the clear mixture of sulphurous acid and chloride of barium contained in these three glasses, we have in each instance an immediate precipitate of sulphate of barium from the oxidation of the sulphurous acid, just as in our former experiments with the peroxides of hydrogen and nitrogen, the reaction being as follows:—

$$\overset{\text{Sulphurous.}}{H_2SO_3} + \overset{\text{Water.}}{H_2O} + \overset{\text{Chlorine.}}{Cl_2} = \overset{\text{Sulphuric.}}{H_2SO_4} + \overset{\text{Chlorhydric.}}{2HCl.}$$

Here, again, I have three white magmas of protoxide of lead, with an excess of dilute alkali, exposed freely to the air. Now, although this protoxide does not absorb oxygen from the air, yet when treated with chlorine, bromine, and iodine, it is at once oxidised more or less completely into the brown peroxide, as you perceive, thus:—

$$\overset{\text{Lead oxide.}}{PbO} + \overset{\text{Water.}}{H_2O} + \overset{\text{Bromine.}}{Br_2} = \overset{\text{Lead peroxide.}}{PbO_2} + \overset{\text{Chlorhydric.}}{2HBr.}$$

Lastly, I have in these three glasses some solution of blue indigo exposed to the air, but unoxidised by the air. On adding chlorine, bromine, and iodine, however, it is at once bleached or oxidised into isatin, thus:—

$$\overset{\text{Indigo.}}{C_8H_5NO} + \overset{\text{Water.}}{H_2O} + \overset{\text{Iodine.}}{I_2} = \overset{\text{Isatin.}}{C_8H_5NO_2} + \overset{\text{Iodhydric.}}{2HI.}$$

In all these particulars, then, chlorine, bromine, and iodine, though so different in their medicinal action, resemble one another to the greatest extent chemically. Now let us see what are their chemical, and, I may add, physical differences. I will first advert to their combining proportions, or the relative weights of each of them, which unite with 1 part by weight of hydrogen. These are indicated by the numbers 35·5, 80, and 127, which also represent their respective specific gravities, when in the gaseous state. You will observe that the proportional number of bromine is intermediate between that of chlorine and iodine, and indeed approximates very closely to the true arithmetic mean, $\frac{242\cdot5}{3} = 80\cdot8$, thus:—

Cl	35·5	Chlorine.
Br	80	Bromine.
I	127	Iodine.
	242·5	

The circumstance of these numbers also expressing the chemical equivalents of the several elements leads us to some curious medico-chemical considerations. Thus, bearing in mind that sodium and potassium are related to one another in much the same way as are chlorine and iodine, though not perhaps quite so intimately, it will follow that 58·5 parts of common salt or chloride of sodium and 74·5 parts of chloride of potassium are the chemical equivalents of 166 parts of iodide of potassium, thus:—

$$\begin{array}{lcccccc} NaCl & = & 23 & + & 35\cdot5 & = & 58\cdot5 \\ KCl & = & 39 & + & 35\cdot5 & = & 74\cdot5 \\ KI & = & 39 & + & 127 & = & 166\cdot0 \end{array}$$

Chemically, then, 58·5 parts of chloride of sodium are just as efficient as 166 parts of iodide of potassium; but while most of us, I suppose, are in the habit of taking fifty or sixty grains of common salt twice or three times a-day, few of us, I conceive, would like to take 166 grains of iodide of potassium even once in the same period.

Now, the gradational difference subsisting between the atomic weights and volume-weights of chlorine, bromine, and iodine is typical of all their chemical and physical differences. Thus, their usual states of aggregation, gaseous, liquid, and solid, and the colours of their respective gases or vapours, green, orange, and violet, are sequential to one another; while, in a chemical point of view, we notice a successive decrease of the force with which they respectively enter into and remain in combination with other bodies. Thus, chlorine combines directly with hydrogen upon simple exposure of the mixed gases to ordinary daylight, and the resulting chlorhydric acid is an extremely stable body. But the direct combination of bromine with hydrogen takes place very imperfectly, and then only at a red heat, while the bromine of the resulting compound is liberated with very great ease. Further, the direct combination of iodine with hydrogen is almost impracticable, while the iodhydric acid resulting from the indirect combination of the two elements is gradually decomposed even by the action of atmospheric oxygen, thus: $2HI + O = H_2O + I_2$. The amounts of heat given out by the combinations of the respective halogens with hydrogen, which are, of course, the measures of the forces required to pull apart the resulting compounds, have not, I believe, been exactly ascertained, though they are obviously sequential, as in the case of the amounts given out during the similar combinations of the halogens with some basylous metals. Thus, when zinc, for instance, combines with an equivalent of chlorine, the amount of heat evolved is nearly twice as great as that produced during its similar combination with an equivalent of iodine; or, in other words, the force with which zinc and chlorine are held together, and consequently the force required to pull them asunder, is nearly twice as great as that with which zinc and iodine are intercombined. Now, it is this feebleness of the force with which iodine enters into combination, and consequent facility with which it is separated from its combinations, that gives to it that peculiar mobility to which I have already adverted. The chief chemical difference, indeed, between chlorine and iodine seems to be that chlorine in the free state is far more active than iodine, and iodine in the combined state far more mobile than chlorine, while bromine occupies an intermediate position. Hence, on adding a little bromine water to the solution of iodide of potassium, the bromine expels the iodine, $KI + Br = KBr + I$; which, dissolving in the chloroform I had previously introduced, manifests itself to you by the production of a beautiful violet-coloured stratum at the bottom of the tube. Similarly when I add a little chlorine water to this solution of bromide of potassium, the chlorine expels the bromine $KBr + Cl = KCl + Br$, which dissolving in the previously introduced ether, floats on the surface as an orange-brown layer, so that while bromine expels iodine, chlorine expels bromine, and *à fortiori* iodine, from their respective combinations. Accordingly, we may regard 35·5 parts of chlorine as an energetic representative of 127 parts of iodine; but it is this very energy of chlorine, I conceive, which disqualifies it for acting medicinally as an alterative. On account of its intense chemical affinity, it unites more rapidly and forcibly than iodine with the different basyloids it may chance to encounter, but directly it has entered into combination with them its work is done, its action ceases. The resulting chloride of sodium, or other chloride, is of so stable a nature as to be impressionable only to violent chemical agencies; whereas, iodine, on the other hand, forming very unstable compounds, is constantly, with every change of circumstance, entering into a fresh state of liberation or combination—constantly effecting fresh oxidising or deoxidising actions.

I have already given you several illustrations of the oxidising action of free iodine, and ought, perhaps, to mention one or two instances of the correlative deoxidising action of combined iodine. For example, when tartaric acid is heated with aqueous iodide of hydrogen or iodhydric acid, it is converted into malic acid with liberation of iodine, thus:—

$$\begin{array}{ccccccccc} \text{Tartaric Acid.} & & \text{Iodhydric.} & & \text{Malic Acid.} & & \text{Water.} & & \text{Iodine.} \\ C_4H_6O_6 & + & 2HI & = & C_4H_6O_5 & + & H_2O & + & I_2 \end{array}$$

Similarly the malic and fumaric acids are reducible into succinic acid by means of iodhydric acid, thus:—

$$\begin{array}{ccccccccc} \text{Malic.} & & \text{Iodhydric.} & & \text{Succinic.} & & \text{Water.} & & \text{Iodine.} \\ C_4H_6O_5 & + & 2HI & = & C_4H_6O_4 & + & H_2O & + & I_2. \end{array}$$

$$\begin{array}{ccccccc} \text{Fumaric.} & & \text{Iodhydric.} & & \text{Succinic.} & & \text{Iodine.} \\ C_4H_4O_4 & + & 2HI & = & C_4H_6O_4 & + & I_2. \end{array}$$

Accordingly, we find that while free iodine, acting as an oxidising agent, produces iodhydric acid, this same acid, acting as a deoxidising agent, reproduces free iodine. Here, for instance, I have some iodhydric acid mixed with a little starch, to show the result of the reactions. I now add to the iodhydric acid some peroxidised substance, which it immediately reduces with liberation of iodine, as shown by the blue colour of the liquid. I now add to the free iodine some suboxidised substance, which it immediately oxidises with reconversion into iodhydric acid, as shown by the disappearance of the blue colour. On now adding some more of the peroxidised substance, I re-liberate the iodine, and, on afterwards adding some more of the suboxidised substance, I reproduce the iodhydric acid, and so on *ad infinitum*. The characteristic chemical property of iodine consists, therefore, in the comparative feebleness of its affinities, or in the loose state of combination with which it is capable of being retained by other bodies; so that, while the more energetic chlorine acts once for all, the less energetic iodine is acting and reacting upon every occasion. Accordingly, while it makes all the difference whether we employ free chlorine or chloride of sodium to produce the therapeutic effects of chlorine, it makes very little difference whether we employ free iodine or iodide of potassium to produce the therapeutic effects of iodine. Wherever the element travels, it either oxidises or deoxidises, accordingly as it comes into contact with bodies more or less oxidisable than itself, at that particular moment. It acts, in fact, not only as a converter of inactive or free into active or combined oxygen, but also as a conveyer of oxygen from wherever it is in excess to wherever it is in deficiency.

Now, what is true of iodine and its compounds is also true of the compounds of mercury, of arsenic, and of another metal whose alterative action is manifested in almost an opposite fashion,—namely, iron. Considered chemically, the compounds of these three metals are, perhaps, the most constantly impressionable of any with which we are acquainted. In the laboratory, and even in the factory, we habitually avail ourselves of mercuric, arsenic, and ferric compounds as oxygenants, and of mercurous, arsenious, and ferrous compounds as deoxygenants or reducants. The phosphoric and arsenic acids, though so different in their therapeutic effects, are the strict chemical analogues of one another, and are associated with one another in much the same way as are chlorine and iodine. Phosphorus is a far more active element than arsenic, and its combinations are far more stable. Phosphate of sodium once formed is like common salt—a stable innocuous body—arseniate of sodium, like iodide of potassium, is an active body, because of its instability—because of the liability of its arsenical constituent to affect and be affected by the chemical actions taking place everywhere throughout the body. I am far, of course, from thinking that this susceptibility to oxidation and deoxidation furnishes a complete solution of the medicinal action exerted by alterative salts. But when we remember that every change effected in the composition of any part of the animal body is a chemical change, necessitating a correlative change in the composition of the reacting substance, it is obvious that we must look for alterative agents among that class of substances which are most susceptible of chemical change; and I would add further, that an explanation of the different kind of alterative effects producible by different classes of compounds, as of mercury and iron, for instance, is, doubtless, to be sought for in the difference of their respective chemical habitudes.

A few words upon the effect of alkalies in promoting oxidation. I mentioned in my last lecture the peculiar decomposition of animal substances resulting from their treatment with caustic alkali, and consisting in an oxidation of their carbonous at the expense of their hydrogenous constituents. Now, this action is apparently determined by the tendency that exists among differently characterised elements to arrange themselves in stable groupings, and more particularly to form stable oxi-salts. The presence of alkali rendering the formation of such salts possible, by furnishing the necessary base, we find that under treatment with caustic potash KHO, for instance, the carbon of organic matter is oxidised into various acids which appear in the form of their respective potassium salts, while the excessive hydrogen of the organic matter, together with that of the potash employed, is liberated in the gaseous state, as exemplified by the reaction of caustic potash upon oil of bitter almonds, already more than once referred to. As a result of this tendency, then, we obtain, as I have previously remarked, very similar products by fusing animal substances with caustic alkalies, and by submitting them to the action of powerful oxygenants. It is observable, however, as well in artificial as in natural processes, that the ultimate effects of a gentle chemical action are often more complete than the immediate results of a comparatively violent one; and it is to this more gentle action of alkalies that I would now direct your attention. We find that many organic substances, which of themselves are scarcely affected by exposure to oxygen or air, undergo a complete and even somewhat rapid oxidation under the influence of alkalies, the tendency of their constituent carbon to become oxidised, otherwise inferior to that of their constituent hydrogen, becoming intensified, apparently because of the opportunity afforded by the presence of the alkali for the formation of salts instead of acids. Be the explanation, however, what it may, the fact is unquestionable, and readily admits of experimental illustration. For instance, I have in this porcelain dish the watery solution of a substance well known to photographers as pyrogallic acid, though its acidity is of such a feeble character that it is nowadays more frequently spoken of by chemists under the neutral appellation of pyrogalline. At present, the solution in the dish, though exposed freely to the air for upwards of an hour, has not undergone any appreciable oxidation. I now moisten the interior of this long tube with a little aqueous potash, and insert it in the solution, when the commencing oxidation of the dissolved pyrogalline is manifested to you by its almost immediate assumption of a brown-black colour, followed by the gradual rising up of the black liquid in the tube, through its partial absorption of the oxygen of the contained air. The pyrogalline, which did not become oxidised in any appreciable degree so long as there was no alkali present, now becomes oxidised with considerable rapidity, as you observe, yielding among other products acetate, oxalate, and carbonate of potassium. A familiar illustration of this action of alkalies is afforded us in the employment of lime to promote the destructive oxidation of dead bodies, and as a manure to destroy the organic matter of peaty soils. Some very interesting results have also been obtained by Gorup-Besanez, who found that glycerine, sugar, leucine, hippuric acid, oxalic acid, and the fatty and aromatic acids, which of themselves were unacted upon by ozonised air, underwent a very complete oxidation when submitted to the same reagent in the presence of caustic or even carbonated alkali. Benzoic acid, for instance, which results from the violent oxidation of animal matter, and consistently resists the action of powerful oxygenants, undergoes a complete and somewhat speedy oxidation when submitted in alkaline solution to the action of ozone. And in some of these oxidations the curious circumstance was noted, that between the original substance, stearic acid $C_{18}H_{36}O_2$, or benzoic acid $C_7H_6O_2$, for instance, and the final carbonic acid, no intermediate products could be detected. It seemed, indeed, as if portion after portion of the original substance was completely oxidised and broken up into separate molecules of carbonic acid, instead of the entire substance undergoing a gradual oxidation and simplification, by the successive burning off of its constituent carbon atoms into carbonic acid. With such facts as these before us, I would suggest that the so-called resolvent action of alkalies upon the animal economy, like that of iodine, is a direct consequence of the peculiar chemical characterisation by which they are enabled to act as oxidising agents.

Despite, however, the interest of these questions, upon which I have been able to bestow but a very hasty notice, I must now break off their discussion altogether, and regretfully take my leave of you. In bringing this course of lectures to a conclusion, I have to thank you all, and more particularly the President and Fellows of the College, for the kind encouragement which your continued presence has afforded me. I am aware how far short these lectures have fallen of that degree of excellence which I had hoped to attain, and you had a right to expect; and how much the measure of success which has attended them must be attributed to the intrinsic interest of the subject, and your good-natured willingness to be pleased with its expounder. I have endeavoured throughout to bring prominently before you the dynamical idea of organic chemistry, as connected with changes of composition. I have shown you that, in the organism of the plant, carbonic acid and water are submitted to a constant deoxidising change, whereby they become successively converted into more and more complex bodies, many of which we are now able to produce, all of which we hope some day to produce, by similar processes in the laboratory; that the change in composition undergone by carbonic acid and water is attended by a storing-up of force in the resulting products, and that the correlative change in composition undergone by these products into water and carbonic acid is attended by a liberation of their stored-up force; that in every organ of the animal body oxidation is continually taking place to supply that organ with the force necessary both for its nutritive acts and external manifestations; that the juice of every gland and muscle is crowded with oxidised products of its own metamorphosis, similar to, or even identical with, those procurable by an artificial oxidation of its own tissue out of the body; that inasmuch as the exercise of every function of the living body is attended by, and consequent upon, a change of chemical composition, the consideration of every action of the body, even of the most mechanical action, becomes to a very considerable extent a chemical question; that while perversions of nutrition, perversions of metamorphosis, and the modifying influence of remedies, are many-sided subjects that may be viewed from many different aspects, he must have but a very imperfect and one-sided view of them, who leaves the chemical aspect altogether out of his consideration.

ACADEMY OF SCIENCES.

October 30.

M. De Cizancourt presented a memoir "*On the Transformations which the Allotropic Conditions of Iron undergo in Metallurgical Operations.*" All these transformations were indicated in the memoir we recently published, and we shall reserve further notice until the author publishes the practical application of his views, which he promises to do immediately.

M. Fouqué has recently examined the "*Gases Escaping from Sources around Vesuvius.*" We may say in a few words that these gases are mixtures of carbonic acid, oxygen, and nitrogen, with very small proportions of marsh and olefiant gases, and no free hydrogen. The author says, "All contain bicarburetted hydrogen, and not one free hydrogen. In Sicily just the reverse was the fact. The more distant the place of disengagement was from Vesuvius the more carburetted hydrogen they contained. And lastly, the gas from Torre del Greco, which contained free hydrogen in 1862, now contains none, but in place of it a small quantity of bicarburetted hydrogen." From which M. Fouqué concludes that the presence of free hydrogen points to a period of greater volcanic activity than protocarburetted hydrogen, and this again to more activity than bicarburetted hydrogen. M. St. Claire Deville added that M. Fouqué's researches seemed to show that the great eruption of Etna coincided with diminished activity in Vesuvius and the group of volcanic islands between them, and confirmed the opinion that there existed some connexion between all these volcanoes.

MM. C. Michaelson and E. Lippman presented a note "*On the Action of Monobromacetic Acid on Aniline.*" The authors have found that this action gives rise to the formation of two bodies, hydrobromate of aniline and *phenylglycocolle.*

M. Sell presented a note "*On a Product of the Oxidation of Erythrite.*" The author effected the oxidation directly by the aid of platinum black, and produced a new acid,

$$\underbrace{\left.\begin{matrix}C_4H_6\\ H_4\end{matrix}\right\}}_{\text{Erythrite.}} O_4 + O_2 = H_2O + \underbrace{\left.\begin{matrix}C_4H_4O\\ H_4\end{matrix}\right\} O_4}_{\text{Now Acid.}}$$

The author is not quite certain of the accuracy of his results.

MM. De Luca and Ubaldini communicated some "*Chemical Researches on the Australian Myrtle (Eugenia Australis).*" The shrub, it seems, grows well in the Botanic Garden at Naples, and the authors have been able to examine the juice of the fruit, which, it appears, may be compared with that of the red grape. It produces a very good wine, exactly resembling red grape wine.

Dr. Phipson communicated a note "*On Zirconium,*" which will be found at page 171 of our present volume.

Numerous communications are still addressed to the Academy every week on the all-important subject of the *Prevention and Cure of Cholera.* With most of these we can have nothing to do, but some have a strictly chemical bearing. For example, at the last sitting M. Elie de Beaumont read a letter from the Inspector-General of Mines in Spain, who points out that at the copper mines of Rio Tinto, in Andalusia (about which some 2000 people reside, and near which, at Seville, for instance, cholera and other epidemics has often raged), cholera has never broken out. The large amount of sulphurous acid disengaged in the process of roasting the ores is supposed to be the protecting agent. At a village two leagues distant, to which cholera had been brought from Seville, the inhabitants had asked for some loads of copper ore to roast in a public place to put an end to the epidemic. M. Fremy subsequently added that a large amount of arsenious acid was disengaged as well as sulphurous acid, and the former agent, used with so much success for several diseases, might also be a preservative. [We should be glad to have the experience of medical men at Swansea and St. Helens on this subject.]

M. Lisle, the Physician to a lunatic asylum at Marseilles, sent an account of his experience on the treatment of cholera with sulphate of copper according to the plan of Dr. Burq, recently noticed by us. It seems to have been highly successful, only five deaths occurring in twenty-six cases. It is noticed also that in most cases the period of convalescence was short. To those interested we may also commend the short address of M. Velpeau, though it is calculated rather to amuse than instruct the reader, especially his story of a country doctor who came up to Paris with a specific for cholera—viz., belladonna, which was freely tried in the Paris Hospitals, but signally failed to do good, and its use was consequently given up; so the Physician went back to his home disgusted with Parisian cholera patients and Parisian doctors.

NOTICES OF BOOKS.

Saint Bartholomew's Hospital Reports. Edited by Dr. Edwards and Mr. Callender. Vol. I. London: Longmans and Co. 1865.

Clinical Lectures and Reports. By the Medical and Surgical Staff of the London Hospital. Vol. II. London: Churchill and Sons. 1865.

The two papers by Dr. Letheby in the Reports of the London Hospital Medical and Surgical Staff are—"On Liquid Diffusion in Relation to Physiology and Toxicology," and "On the Poisonous Properties of Essence of Mirbane or Artificial Oil of Bitter Almonds" (Nitrobenzole). We cannot here do more than refer our readers to the important remarks of Dr. Letheby on dialysis in relation to physiology, and must confine ourselves to an account of the author's own experiments as to the value of dialysis in toxicological investigations. It will be remembered that Mr. Graham, in his first communication on the subject, pointed out the applicability of the process in the discovery of poison in the fluids and tissues of the body, and detailed some experiments which proved that in the case of arsenious acid the greater part passed from a solution containing organic matters into the diffusate in the course of twenty-four hours.

It is the quantitative results of the process to which Dr. Letheby has mainly directed his attention, and we now extract the conclusions at which the author has arrived. After quoting Mr. Graham's results, he proceeds:—"I have noticed, however, that a notable proportion of organic matter invariably passes out with the arsenic, some of which is coagulated by heat and acids, and is, therefore, albuminous, while a portion of it still remaining in solution after the action of the heat is thrown down with the tersulphide of arsenic, when the diffusate is treated with sulphuretted hydrogen; and unless the sulphide of arsenic is purified by treatment with ammonia, or by some other process, a false result as to quantity is obtained. In illustration of this, and of some other points of interest, the following experiments are cited:—These experiments were made with two sets of dialysers of different diameters, each set being composed of a dialyser with a parchment paper septum, and another with bladder. One set was 4·3 inches in diameter, with a superficial area of 14·5 square inches, and the other set was 3·5 inches in diameter, with an area of 9·6 inches. The liquid dialysed was two fluid ounces of thick soup made with meat, bread, and potatoes, in which one grain of arsenious acid was dissolved, and the dialyser was floated in a vessel containing twelve fluid ounces of water. The diffusion was continued for two days, and then the water was changed every twenty-four hours.

Dialysis of Soup containing One Grain of Arsenious Acid.

Time.	Dialyser, 4·3 in. diameter.				Dialyser, 3·5 in. diameter.			
	Bladder.		Parchment paper.		Bladder.		Parchment paper.	
	Impure tersulphide of arsenic.	Impure arsenious acid.	Impure tersulphide of arsenic.	Impure arsenious acid.	Impure tersulphide of arsenic.	Impure arsenious acid.	Impure tersulphide of arsenic.	Impure arsenious acid.
	grs.	grs.	grs.	grs.	grs.	grs.	grs.	grs.
1st and 2nd day.	1·6	1·28	1·4	1·12	0·7	0·56	0·9	0·72
3rd day . .	0·4	0·32	0·8	0·64	0·2	0·16	0·2	0·16
4th ,, . .	0·0	0.00	0·1	0·08	0·2	0·16	0·0	0·00
5th ,, . .	0·2	0·16	0·4	0·32	0·5	0·40	0·2	0·16
6th ,, . .	0·2	0·16	0·1	0·08	0·3	0·24	0·4	0·32
Total . .	2·4	1·92	2·8	2·24	1·9	1·52	1·7	1·36

"It is evident, therefore, that much organic matter had diffused out with the arsenic, and had gone down with the tersulphide when the liquid was treated with sulphuretted hydrogen. It is evident, also, that the great bulk of arsenic diffuses out in the first forty-eight hours." The same things happen when a solution of tartar emetic is submitted to dialysation. We again quote Dr. Letheby's experiments:—

Dialysis of Soup containing 5·6 Grains of Tartar Emetic.

Time.	Bladder dialyser, 3·4 inches.		Parchment paper, 3·5 inches.	
	Impure tersulphide of antimony.	Impure tartar emetic.	Impure tersulphide of antimony.	Impure tartar emetic.
	grs.	grs.	grs.	grs.
1st day .	0·6	1·21	0·3	0·61
2nd ,, .	0·4	0·81	0·3	0·61
3rd ,, .	0·5	1·01	0·1	0·20
4th ,, .	0·0	0·00	0·0	0·00
Total .	1·5	3·03	0·7	1·42

"So that the quantity of impure tartar emetic obtained with the bladder dialyser was nearly six times as great as the quantity used."

With some special precautions, the process of dialysis is applicable to the separation of all metallic poisons; but "in all those cases where the poison forms an insoluble compound with the albumen or fibrine of the food or tissues of the body, or with the saline constituents of the food and secretions, it is necessary to render it soluble. This is the case with the salts of lead, zinc, mercury, copper, &c.; and in those cases the compound must be dissolved by boiling it in water strongly acidulated with hydrochloric acid."

Nor is dialysis of less use in the detection of organic poisons. "The salts of the organic alkalies dialyse with the greatest facility; so that when a suspected substance is acidulated with acetic or muriatic acid, and dialysed for twenty-four hours, the salt of the alkaloid is found in the diffusate in a condition for analysis. The diffusate should be carefully evaporated to dryness, or nearly to dryness, and the residue treated with carbonate of soda, and then with alcohol, ether, chloroform, and acetic ether to separate the alkaloid from the saline and other matters with which it is mixed. In this way a very small proportion of strychnine and brucia may be discovered; and M. Grandeau has separated digitaline and morphia from the contents of the stomach.

"In conclusion, therefore, it may be said that although the process of dialysis is not well suited for determining the quantity of any poison present, yet it furnishes a very easy and reliable means of discovering the fact of its presence. It is, in fact, a remarkably simple and trustworthy process for effecting a *qualitative* examination of suspected matters; and, above all, it enables the operator to pursue his inquiries without the risk of having his results vitiated or rendered doubtful by the use of reagents of questionable purity. Looking, also, at the facility by which the process is effected by an animal membrane, it is easy to perceive in how many ways it may be readily applied. In a case of suspected poisoning, for example, it is only necessary to place the contents of the stomach in a clean pint basin, and to tie it securely over with a piece of well-soaked bullock's bladder, and to float it, bladder downwards, in another vessel containing six or eight times their bulk of water, and to allow it to dialyse for forty-eight hours, when, in a majority of cases, the poison will be separated in such a condition as to be easily recognised. The value of the process in medico-legal researches is manifestly great; but how far the elaborate investigations of Mr. Graham may go towards the solution of physiological problems can hardly yet be determined, notwithstanding that their applications to the subject are strikingly obvious."

The practical suggestion contained in this last paragraph is worthy of being followed in all cases before proceeding to other methods; but it must never be concluded that no poison is present in the contents if none should be found in the diffusate Perhaps it would be as well in every case to acidulate the contents with acetic acid before tying them down in the basin.

Want of space compels us to leave the paper on the poisonous properties of nitro-benzole for another notice.

Des Odeurs, des Perfums et des Cosmetiques, Histoire Naturelle, Composition Chimique, Preparation, Recettes, &c., &c. Par S. Piesse. Edition Française. Par O. Reveil. Paris: J. B. Baillière et Fils. 1865.

This is a French translation of the well-known work by Dr. Septimus Piesse, with additions by the French editor. These additions, we may say shortly, add considerably to the value of the book, giving, as they do, later information on some chemical points, and comprising some French receipts which look useful. Either this or the original will be found extremely useful as well as pleasant reading by druggists and perfumers.

The Ophthalmic Review. No. 7. October, 1865.

We need only notice the regular appearance of this excellent journal, with the usual selection of valuable and interesting papers.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

2322. W. Hewitt, Pimlico, "An improved composition for preventing incrustation in steam boilers."—Petition recorded September 11, 1865.

2653. W. J. C. MacMillan, J. Mason, and J. V. Scarborough, Sunderland, "A certain composition having anti-corrosive and anti-fouling properties for the preservation of and keeping clean the bottoms of iron vessels, and also for the preservation of iron submerged and iron structures exposed to the action of the atmosphere or water."

2657. J. C. Ridley, Newcastle-on-Tyne, "Improvements in apparatus for applying carbonic and other gases to iron and other metals in a molten state."—October 14, 1865.

2694 T. King, Park Road, Holloway, "Improvements in the manufacture of chemical toys, known as 'Pharaoh's serpents.'"—October 18, 1865.

2701. W. Clark, Chancery Lane, "Improvements in printing or impressing and dyeing fabrics and tissues." A communication from F. Déhan, Boulevart St. Martin, Paris.—October 19, 1865.

Notices to Proceed.

1790. A. V. Newton, Chancery Lane, "Certain improvements in the manufacture of superphosphate of lime from guano." A communication from G. A. Liebig, Baltimore, Ma., U.S.A.—Petition recorded July 6, 1865.

2448. W. Unwin, Sheffield, "Improvements in the manufacture of iron."—September 25, 1865.

2559. W. H. Phillips, Nunhead, Surrey, "Improvements in apparatus and means for extinguishing fires, part of such improvements being applicable to other purposes."—October 5, 1865.

2648. J. De Witt Brinckerhoff, New York, U.S.A., "An improvement in preparing paper and the surfaces of other materials for use in photography."—October 13, 1865.

CORRESPONDENCE.

How Things are Done at South Kensington.

To the Editor of the Chemical News.

Sir,—In your impression of Friday last you gave the names of the candidates who at the last May examination obtained Exhibitions to the Royal School of Mines, &c. As I have reason to believe there is a great deal of "red-tapeism" and considerable mismanagement in connection with the South Kensington Examinations in Science and Art, I shall feel obliged if you will make the following facts public:—

There being no examination held in Sheffield, I, in May last, went to the inconvenience and expense of remaining more than three weeks in London, for the express purpose of passing the examinations and obtaining an exhibition to the Royal School of Mines. I received notice of my success in the different subjects towards the end of June and beginning of July, and heard nothing more in reply to my inquiries until after the commencement of the session, which began on October 2. Then came the list announcing the medals I had obtained, but still no word of my success or failure. As the lectures had commenced, I of course imagined I had been unsuccessful, and reluctantly entered into other engagements. I afterwards received from South Kensington a letter dated October 16 (just one fortnight after the first lecture had been delivered), saying:—"You have obtained a Royal Exhibition to the Royal School of Mines, and request that you would join as soon as possible, as the session has already commenced."

Now, Sir, it is not likely mine is a solitary instance; but is it not very disappointing, to say the least of it, that candidates should be unable to have the reward of their exertions and expense because of the dilatoriness of some lazy Government official?

Having by this communication warned future candidates of the treatment they are liable to receive, and, perhaps, prevented them from suffering a similar disappointment to mine, I will no longer trespass on your valuable space.

I am, &c. Alfred H. Allen.

1, Surrey Street, Sheffield, November 7

Effects of Sulphuretted Hydrogen.

To the Editor of the Chemical News.

Sir,—Mr. Kopp mentions in his letter to you, contained in your last number, as a fact not yet noticed in print, that those workmen who have to deal with sulphuretted hydrogen suffer very much from an inflammation of the eyes. I have had occasion, in manufacturing practice, to notice this fact six years ago, when I put some workmen to stir liquors evolving this gas; one after the other was seized by an inflammation of the eyes, which caught at last myself. When proper precautions had been taken to remove the gas, the inflammation gave way at once. Like Mr. Kopp, I do not recollect having seen this curious fact mentioned in print before.

I am, &c. Geo. Lunge, Ph.D.

10, Albert-terrace, South Shields, Nov. 5.

MISCELLANEOUS.

Wholesale Poisoning.—A remarkable case of wholesale poisoning by mistake recently occurred in the town of Shiloh, Randolph County, Illinois. Two physicians, Drs. Campbell and Minner, residing in the town, sent to a drug store in the neighbouring village of Chester for a quantity of calomel. In the course of one day this calomel was administered to some forty persons. All of these persons were taken violently ill, and on examination it was found that large quantities of corrosive sublimate had been mixed with the calomel. Further inquiry showed that the drug thus adulterated had not been tampered with by the apothecary in Chester, for calomel mixed with corrosive sublimate was found in the warehouse of the wholesale dealer in St. Louis, from whom the retailer had purchased it; and on following up the investigation it became evident that the presence of the poison was due to the carelessness of the British manufacturer of the calomel. Seven of the victims of this dreadful mistake have already died in the town of Shiloh alone. How much further the results of the blunder have extended or will extend it is now impossible to say. The St. Louis dealer had sent the adulterated calomel all over the South-west, as well as to many sections in the West, and while the authorities are doing their best to obtain possession of the "doctored" stuff, it is not impossible that the fatal results of its use have not yet ended.—*American Cor. of Standard.*

Action of Chlorine on Aloes.—Dr. C. Finckh has repeated Roubiguet's experiments, and found that the action of chlorine, whether on an aqueous or alcoholic solution of aloes, produces only chloranil $C_6Cl_4O_2$.—*Annal. der Chem. und Pharm.*, 134, 241.

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. *Private* letters for the Editor must be so marked.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

W. H. J. T.—The oxalic acid process would be the cheapest.

Mr. Walker's communication is unavoidably postponed until next week. The patents have not reached us.

F H S—We do not believe that any reaction would take place under the circumstances; but if any did no oxygen would be evolved.

Received with Thanks.—Professor How, Nova Scotia; Jeremias; B. W Gibsone, F.C.S.

Books Received.—"Rinderpest, its Prevention and Cure; and Gypsum as a Sanitary Agent," by J. J. Lundy, F.G.S., &c.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

A Lecture Experiment, by K. Kraut.[*]

Take a platinum wire 0·5 mm. thick, and wind it fifteen or twenty times around a lead pencil, so as to form a spiral; when made, pass one end of the wire through a cork, and let the spiral hang into a wide-necked flask standing on wire gauze over a lamp. The cork must be loosely laid lengthwise over the mouth of the flask. Pour into the flask so much liquor ammonia (20 per cent.) as almost to reach to the end of the spiral. Carry a glass tube, about 10 mm. wide, from a gasometer full of oxygen, into the flask, so that the end of the tube may dip a little under the ammonia. Now make the platinum spiral red hot, and allow the oxygen to enter. The platinum soon becomes heated to a bright red heat, and the flask is filled first with white vapours of nitrite of ammonia, and then with deep red vapour of nitrous acid; the glass tube which carries the oxygen becomes coated with a thick crust of nitrite of ammonia. If now the lamp under the flask be lighted and the ammonia heated, the mixture of ammoniacal gas and oxygen explodes with a quite harmless explosion. By this the platinum spiral is cooled below the temperature of a red heat; but after a few moments it again becomes a bright red, and the gaseous mixture is exploded as before, so that the experiment goes on repeating itself as long as desired. On introducing a very rapid stream of oxygen the gas burns for some time under the liquid. It concontinues to burn, producing the long-drawn sound of the chemical harmonica if the opening of the tube be held immediately above the level of the ammonia and quite close to the platinum spiral. The oxygen-ammonia flame then appears as a greenish yellow bubble at the mouth of the tube, which may be moved up and down without extinguishing the flame.

Detection of Antimony in Tube Sublimates, by E. Chapman, *Ph.D., Professor of Mineralogy and Geology, Toronto.*

In the examination of mineral bodies for antimony, the test substance is often roasted in an open tube for the production of a white sublimate. The presence of antimony in this substance may be detected by the following process—a method more especially available when the operator has only a portable blowpipe-case at his command:—The portion of the tube to which the chief part of the sublimate is attached is to be cut off by a triangular file, and dropped into a test tube containing some tartaric acid dissolved in water. This being warmed or gently boiled, a part at least of the sublimate will be dissolved. Some bisulphate of potash—either alone, or mixed with some carb.-soda and a little borax, the latter to prevent absorption—is then to be fused on charcoal in a reducing flame; and the alkaline sulphide thus produced is to be removed by the point of the knife-blade, and placed in a small porcelain capsule. The hepatic mass is most easily separated from the charcoal by removing it before it has time to solidify. Some of the tartaric acid solution is then to be dropped upon it, when the well known orange-coloured precipitate of SbS_3 will at once result.

In performing this test, it is as well to employ a somewhat large fragment of the test substance, so as to obtain a thick deposit in the tube. It is advisable also to hold the tube in not too inclined a position, in order to let but a moderate current of air pass through it; and care must be taken not to expose the sublimate to the action of the flame, otherwise it might be converted almost wholly into a compound of SbO_3 and SbO_5, the greater part of which would remain undissolved in the tartaric acid solid. A sublimate of arsenious acid, treated in this manner, would, of course, yield a yellow precipitate, easily distinguishable by its colour, however, from the deep orange antimonial sulphide. The crystalline character, &c., of this sublimate would also effectually prevent any chance of misconception.

Detection of Minute Traces of Copper in Iron Pyrites and other Bodies, by E. Chapman, *Ph.D., Professor of Mineralogy and Geology, Toronto.*

Although an exceedingly small percentage of copper may be detected in blowpipe experiments by the reducing process, as well as by the azure-blue coloration of the flame when the test-matter is moistened with chlorhydric acid, these methods fail in certain extreme cases to give satisfactory results. It often happens that veins of iron pyrites lead at greater depths to copper pyrites. In this case, according to the experience of the writer, the iron pyrites will almost invariably hold minute traces of copper. Hence the desirability, on exploring expeditions more especially, of some ready test by which, without the necessity of employing acids or other bulky and difficultly portable reagents, these traces of copper may be detected.[*] The following simple method will be found to answer the purpose:—The test substance, in powder, must first be roasted on charcoal, or, better, on a fragment of porcelain,[†] in order to drive off the sulphur. A small portion of the roasted ore is then to be fused on platinum wire with phosphor salt; and some bisulphate of potash is to be added to the glass (without this being removed from the wire) in two or three successive portions, or until the glass becomes more or less saturated. This effected, the bead is to be shaken off the platinum loop into a small capsule, and treated with boiling water, by which either the whole or the greater part will be dissolved; and the solution is finally to be tested with a small fragment of ferrocyanide of potassium ("yellow prussiate"). If copper be present in more than traces, this reagent, it is well known, will produce a deep red precipitate. If the copper be present in smaller quantity—that is, in exceedingly minute traces—the precipitate will be brown or brownish-black; and if copper be entirely absent, the precipitate will be blue or green—assuming, of course, that iron pyrites or some other ferruginous substance is operated upon. In this experiment the preliminary fusion with phosphor salt greatly facilitates the after solution of the substance in bisulphate of potash. In some instances, indeed, no solution takes place if this preliminary treatment with phosphor salt be omitted.

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[*] *Annalen der Chemie und Pharmacie,* October, 1865, p. 69.

[*] In blowpipe practice—as far, at least, as this is possible—the operator should make it an essential aim to render himself independent of the use of mineral acids and other liquid and inconvenient reagents of a similar character. If these reagents cannot be dispensed with altogether, their use, by improved processes, may be greatly limited.

[†] In the roasting of metallic sulphides, &c., the writer has employed, for some years, small fragments of Berlin or Meissen porcelain, such as result from the breakage of crucibles and other vessels of that material. The test substance is crushed to powder, moistened slightly, and spread over the surface of the porcelain; and when the operation is finished, the powder is easily scraped off by the point of a knife-blade or small steel spatula. In roasting operations, rarely more than a dull red heat is required; but these porcelain fragments may be rendered white-hot, if such be necessary, without risk of fracture.—*Canadian Journal,* September, 1860.

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TECHNICAL CHEMISTRY.

The Ores of Manganese, and their Uses, by HENRY HOW, *D.C.L., Professor of Chemistry and Natural History, University of King's College, Windsor.*[*]

A VERY interesting, and, to all present appearances, valuable addition to the mining industry of the province has been made within the last three years by the working of the ores of manganese. Having been engaged in examining and reporting on the quality of these ores for those originally concerned, and having visited the scenes of operation, I requested and obtained permission to include such information I had gathered by these means in a general account of the manganese ores of the province at present known to me. Having been, moreover, kindly furnished with sundry details of interest from various sources, I propose now to continue, on this subject, my Notes on the Economic Mineralogy of Nova Scotia, of which the first part was published in the last volume of the *Transactions* of the Institute.

The only deposits of manganese mentioned in Dawson's Acadian Geology are an impure bed near Cornwallis Bridge, that at Musquodoboit, and those in the iron veins of Shubenacadie and in the limestones of Walton and Cheverie, of which latter it is said (p. 239):—"Small quantities have been exported. I have no doubt that if the limestones can be profitably quarried on a large scale, the manganese might be separated and form a considerable additional source of revenue; but it seems doubtful whether mining operations for the manganese alone can be carried on without loss."

The ores of manganese found here in quantity are Wad or bog ore; manganite, which may be called hard grey ore; and pyrolusite, which may be distinguished as soft black lustrous ore, and is often mixed with psilomelane, a hard black ore not so lustrous as the last-named.

Wad.—The first of these is a black earthy substance, which is found in rounded lumps and grains. It has been sent to me from Parrsborough, and from another locality, I believe to the east of Halifax, where it is found in lumps mixed with stones; the sample I examined contained a great deal of water, and, when dried, 56 per cent. of binoxide of manganese, with the traces of cobalt which are usually found in this species. Neither of these would be valuable as ores of manganese, but they would probably serve as paints. Bog manganese is often mixed with bog iron ore, and then forms deposits of a brown or chocolate colour, called ochres or mineral paints. The paints of Bridgewater and Chester furnish examples. In the first of these I found only 11 per cent., and in the second about 20 per cent. of binoxide of manganese. It is said to be useless to send to (the English) market ores containing less than 65 per cent. binoxide.

Manganite.—This is a very hard ore, which is found in compact lumps of a steel grey colour and submetallic lustre, giving a reddish-brown streak to a file. It is often found in the neighbourhood of the next mentioned; it occurs abundantly at Walton and Cheverie, and is met with at Douglas and Rawdon. At Walton I have picked it out of the stone-heaps in fields near the river, and was told that a bed of it crops out on the bank of the river near the bridge. It is found at Cheverie in nodules on the beach about twenty rods above high-water mark, and has been dug on the upland less than two miles from the beach; it was formerly shipped, but to what extent does not appear to be known. As it is very hard, and contains in its purest form only about 49 per cent. binoxide, this ore is not useful for the ordinary applications of manganese; but I was informed by a gentleman from Boston, dealing in these ores, that it answers for a certain secret process better than the rich soft ore, and that something like fifty tons were sold in the United States in 1863, and that it was hoped the demand would increase.

Pyrolusite.—This is the ordinary marketable ore, and is entirely composed of binoxide of manganese. It is so soft as to be easily scratched with a knife to a black powder, and is found in masses which are more or less glistening, and often very beautifully crystallised in black lustrous needles and prisms. It is met with near Kentville, King's County; near Pictou, Pictou County; near Amherst, Cumberland County; at Musquodoboit, Halifax County; and at Walton, and other places, especially at Teny Cape in the township of Kempt, in Hants County. These two latter are the only localities at which mining operations have been carried on, small quantities of ore having formerly been shipped from Walton, where, on one occasion, seven barrels were got out in cultivating a garden, and considerable returns, as will presently appear, having been made at Teny Cape. The first considerable collection of ore sent from the last-named mines was landed at Windsor in June, 1863, for transmission to England. It consisted of thirty-three barrels, equal to about seven and a-half tons English; it was picked ore, and looked very rich and uniform in quality; the highest percentage of binoxide I know of from Teny Cape was found in a sample I put in the hands of Mr. D. Brown, a pupil of mine, who obtained 96 per cent., and when this lot of ore was sent to England it averaged, on analysis in Liverpool, 91·5 per cent. binoxide, and gave less than ¼ per cent. iron; it sold there half for 8*l.* 10s., half for 9*l.* sterling per ton, being disposed of to different buyers. Messrs. Tennant, of Glasgow, great consumers of manganese, are reported to have said they had never seen ore so fine.

The second mine in operation at Teny Cape was opened up by Messrs. Weeks and Co. Operations were commenced early in 1864, and during the year about eight tons (English) of ore were sent to Liverpool, where they realised 8*l.* 5s. stg. per ton.[†] One great advantage of this locality is that the Basin of Minas is only about a mile and a-half distant in a direct line, and the intervening country is such that a road can easily be made from the mines to the place of shipment.

Hants County possesses a variety of manganese ores in localities widely separate from each other; it has been mentioned that seven barrels of ore were on one occasion dug up in cultivating a garden at Walton; of the quality of this I know nothing, but that valuable ore is found at Walton I am certain, inasmuch as a party of which I was one extracted several pounds at a locality in the woods about seven miles from Teny Cape; one piece of this is sent to the Dublin Exhibition, and is quite as rich to all appearance as that from Teny Cape.[‡] About twelve miles south of these places Mr. Mosher has met with large detached pieces of ore; one weighing

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[*] Abstract from the *Transactions* of the Nova-Scotian Institute of Natural Science.

[†] A third mine has been opened by Messrs. Hamilton and Dawe, and a good deal of ore has been raised.

[‡] Five tons were afterwards taken out here by Mr. J. Brown.

thirty-five pounds was sent to the Exhibition of 1862 and remains in England; it consisted of pyrolusite and psilomelane; it gave to Mr. Poole, one of my pupils, about 84·5 per cent. binoxide; another large mass found in the same region weighed 184 lbs. I do not know of what kind of ore it consisted. The rock holding the manganese at Teny Cape is a limestone containing a good deal of magnesia, and coloured either grey or red by oxide of iron; it is soft, and easily detached from the ore; barytes is frequently seen crystallised through the ore, and carbonate of lime (calcite) is sometimes found beautifully crystallised in various forms encrusting the ore. At Walton the manganese is sometimes associated with iron ore (limonite), and occurs in limestone.

Uses of Manganese Ores.—These ores are employed for a variety of purposes in certain manufactures of purely chemical character, or in which the aid of chemistry is necessary, and according to the application to be made of them they are required of different degrees of purity; in most cases a tolerably high percentage of the particular oxide of manganese, called the binoxide, peroxide, or available oxide, is necessary, and for certain uses there must be little else in the ore, and especially iron must be either absent or present in extremely small proportion. The manufactures in which the ores are used are principally those of bleaching powder, glass, pottery, iron, some brown colours used in dyeing, and manganates and permanganates for certain oxidising processes (as bleaching fats) and for disinfecting. The native oxide is used for making boiled oil, and has also been recommended as a deodoriser and purifier of water, and a cheap agent for extracting gold from quartz.

It is perhaps impossible to learn the total consumption of the ore for these purposes; we know, however, that Great Britain is the great seat of the chemical manufactures, and we have some facts to guide us to an estimate of the amount used there in the processes requiring the largest quantity; these I will now give, together with a rough estimate of the consumption in the United States. The most extensive use of the ore is in the making of bleaching powders (chiefly chloride of lime). According to the report previously quoted, the amount of manganese imported into the Tyne district alone for this purpose was then (1863) given as 11,400 tons per annum, at 4*l.* stg. per ton. Although this district is a very considerable seat of chemical manufactures, there are other parts of the kingdom where very large quantities of manganese are required, among which, the most important are Liverpool, the seat of Messrs. Muspratt's, and Glasgow, of Messrs. Tennant's works. Accordingly, we find in the "Statistics of the Alkali Trade of the United Kingdom for 1862," that the annual consumption of manganese was then 33,000 tons for the manufactures depending on the products of the alkali trade—viz., soap, glass, paper, cotton, woollen, linen, colour making, and all chemical manufactures of any magnitude. This estimate, however, takes no account of the ore used in making iron, and the demand for bleaching powder has been increasing of late years, partly owing to the use of grass, and perhaps of other materials, in the making of paper. The quantity of manganese ores used in the United States was a year ago estimated by a gentleman dealing in them in Boston, at about 500 tons per annum, by another gentleman this year at 1000 tons.

With regard to the quality of the ore required in certain cases, it is found that in making bleaching powder, the ordinary ores, containing from 65 to 75 per cent. binoxide along with water, oxide of iron, carbonate of lime, barytes, etc., answer so good a purpose, that the rich pure ores, such as that from Teny Cape, are not bought for this use, unless at a price far below that given by those who require only such ores. One of the firm of Tennant and Co. (makers of bleaching powder), said, for example, that he could not afford to use Teny Cape ore, meaning, I suppose, at the high price it would fetch from glass makers, for, as J. Outram, Esq., jun., informed me, the Spanish ore of from 70 to 75 per cent. binoxide, sells for 55s. to 60s. sterling per ton, and therefore the bleaching powder makers will give only about 5*l.* 10s. for Teny Cape ore, containing upwards of 90 per cent., while, as we have seen, this actually brought as much as 9*l.* and even 10*l.* stg. per ton. This high price was given by glass and pottery makers who require an ore as free as possible of iron; this, at any rate, is the case with the former, who employ it to remove the stain of iron from the finest kinds of glass. Mr. Outram said that he thought even 2 or 3 per cent. of iron would interfere with the sale of ore at 93 per cent. binoxide for this purpose, and it was because the Teny Cape ore gave less than ½ per cent. of iron, with 91·5 per cent. binoxide of manganese, that it brought the high prices obtained. The demand for these pure rich ores is comparatively limited, perhaps a few hundred tons a year are fully as much as would find sale at the highest prices named. That there is always a steady demand for ore useful for making bleaching powder, is shown by the efforts made to restore to its original state the oxide employed; patents have been taken out for this purpose, and one is recommended by its owner as restoring the material to 52 per cent., and as being capable of bringing it up to 70 per cent. binoxide, which, as we have seen, is a very moderate percentage in the ores.

With regard to the other applications of manganese, the making of iron and steel is the most important. Manganese renders iron tough, and steel better and more durable; in the latter case it acts by removing sulphur and silicon. Although the quantity of manganese actually imparted to the iron and steel is very small, in a manufacture of such enormous proportions the consumption must be large if continued. The making of manganates and permanganates, which are used as oxidising agents and in disinfecting, must also be extensive, a prize medal having been given to Mr. Condy in 1862 for the manufacture of such salts on the large scale.

As an illustration of the way in which the ores are sometimes treated in practice, I may mention the mode adopted by Mr. Hobbs, of Boston, who has had a great deal to do with the Upham and Shepody ores of New Brunswick. The ore is washed clean at the mines, boxed up, and sent to Boston, when it is selected into three good qualities and refuse; the three good sorts are ground in three mills till fine as flour, put up in barrels papered inside, and the contents of each barrel are assayed and sold according to assay.

The first quality free (?) of iron and containing about 98 per cent. of peroxide of manganese, is used for making the finest (flint) glass. The second quality (also no doubt pretty free of iron) containing from 75 to 80 per cent. peroxide, is used for making white phials. The third, containing about 70 per cent. peroxide, is employed for making common glass bottles; while the refuse, containing perhaps 25 or 30 per cent. iron, is used either in making clear amber-coloured bottles for brandy, &c., or for carboys.

In conclusion I state together the quantities of binoxide of manganese contained in some of the Nova

Scotian ores, as found by the experiments of my pupils or myself:—

	Per cent. Binoxide.
Manganite, from Cheverie, Hants Co., air-dry, gave	47·73
Wad, from Halifax Co. (?), dried at 212°, gave	56·00
Pyrolusite and Psilomelane, from Douglas, Hants Co., air-dry, gave	84·62
Pyrolusite, Teny Cape, Hants Co., No. 1, air-dry, gave	88·01
Pyrolusite, Teny Cape, Hants Co., No. 2, air-dry, gave	92·69
Pyrolusite, Teny Cape, Hants Co, No. 3, dried at 212°	95·00
Pyrolusite, from Cumberland Co., dried at 212°, gave	97·04

These results relate to the most important character of the ores; in the rich samples the amount of iron was generally very small; other analytical details are omitted, as this paper is perhaps long enough already. It is apparent, I think, that ores of manganese are likely to prove of considerable importance in the economic mineralogy of the Province.

The Past and Present History of Alum, by J. CARTER BELL, *Esq., F.C.S., Associate of the Royal School of Mines, London.*

(Continued from page 221.)

The alum is made direct from the shale found underlying the seams of coal in South Lancashire. The shale is black from the organic matter contained in it, which amounts to about 5 or 10 per cent. It is piled in heaps about twenty feet long, four to five feet high, and two to three broad. There is a brick drain along each to supply air. The heaps are ignited by a small quantity of burning coal, and the combustion goes on by itself. It is thus slowly calcined at a heat approaching to redness, the object being to render the alumina of the shale soluble in sulphuric acid. If the temperature be too high the clay vitrifies, and the alumina is then insoluble in sulphuric acid. The calcination lasts ten days; when finished the shale is of a pale red colour. It is then put into long tank-like vessels, about forty feet long, ten feet wide, and about three deep; they are technically called pans; they are made of sheets of cast-iron screwed together. These pans are lined with lead. When they are ready to be charged with shale the bottom of each pan is covered with tiles about nine inches square—this is to prevent the shale coming in contact with the lead, because the heat would dry the shale and burn the lead. The charge for one pan is about twenty tons. It is digested with about ten tons of sulphuric acid of sp. gr. 1·25. For about four or five days the liquid is kept up to a temperature of about 220° Fahr., partly by fire underneath the pans, and by the introduction of ammonia from gas liquor, which is boiled down in boilers; steam is also driven in, which raises the temperature considerably. From time to time the liquor is tested to see if it be of the proper strength. A small quantity is put into a square shallow leaden dish, and according to the time it takes to crystallise it is known whether the liquor is ready to be drawn off into the coolers. The cooler is a large rectangular leaden vessel about twenty-nine feet long, seventeen feet wide, and one foot nine inches deep. When the liquor is in the cooler it is constantly agitated with a long wooden arm (worked by a steam-engine) to prevent the formation of large crystals. On an average the liquor is left in the cooler for about fourteen hours; at the end of that time there is a bed of small crystals deposited several inches in depth. The deposit has a greenish colour, due to sulphate of iron. These crystals are then thrown into a large square box lined with lead. They are then washed by means of the mother liquor, and the crystals allowed to drain. This operation takes about two hours. When they are thoroughly washed, the crystals are thrown upon an iron grating, the bars being about half an inch apart from each other. This is done to break the lumps and wash out the mother liquor. Now the alum is ready to be re-dissolved by steam. For this purpose a strong cylindrical vessel is used, from two to three feet high and about two feet in diameter. It has two divisions; one part of the cylinder is open to allow the crystals to be thrown in, the other part has a division and is closed. This division is to prevent large crystals passing without being dissolved. At the bottom of the open part of the cylinder is a coil of lead pipe containing small holes, through which a current of steam, about twenty pounds pressure, is driven through these holes, which, passing through the alum, dissolves it as fast as one man can throw it in. At the top of the cylinder is a pipe, which communicates with a wooden tank lined with lead, and which is called the dissolving box; it is three feet deep, fourteen long, and eight broad; this is to receive the solution of alum before it is drawn off into the tubs or roaching pans; the solution remains in this tank for about three hours; it is covered over with boards, and the joints closely packed with cotton waste. When this tank is nearly full, and while the steam is still on, about four quarts of size are poured in by means of a pipe; this is to cause the floating impurities to settle. When the solution is ready to be tapped off into the crystallising vessels, the tubs which are at the other end of the shed (say sixty feet from the tank) are filled a few minutes before those that are closer; the solution is hotter and the stream swifter, because the appearance of the alum after crystallisation depends upon the temperature at which the boxes have been filled. When it is too hot it forms large crystals outside, and when the temperature is right the outside of the block of alum is like a loaf of sugar; the crystallising tubs are built in pieces. At the bottom is a large round flagstone, and the pieces (each of which is lined with lead) are built round it, and kept in their places by strong iron hoops screwed together. The diameter of the tubs is wider at the bottom than the top, and they are about six feet high. When the hot solution is drawn off into these tubs, they are covered with a wooden cover. In about four days the sides of the tubs can be taken down, as there will then be a sufficient thickness of alum to hold the mother liquor; it now stands in this condition for about fourteen days longer. A hole is then made in the lower part of the block for the liquor to run out, which is collected in a tank. The block is then broken up, and the inside is studded with beautiful crystals, which have a slight violet colour, due most likely to some of the aniline colours. The alum is now ready for the market. One of these blocks weigh about four tons; the bottom part, which is not so white and clean as the other, is returned to the dissolving box; the alum crystallises in truncated octahedrons.

The present employment of alum in the arts is very extensive; it is largely used by the calico printers, from which they prepare the acetate of alumina, as this is used for a mordant in dyeing and calico-printing, and is generally prepared by precipitating alum with acetate of lead. Acetic acid retains the alumina with less energy than the other acids, for which reason this salt is now generally substituted for alum, because the acetic acid gives up the alumina with such readiness that mere elevation of temperature is sufficient to effect the separation of these two substances. Alum is largely used in the manufacture of paper, for the size it contains is to prevent decomposition, and also in bookbinders' paste, which is made of flour and one-sixth of alum. In the preparation of leather baths of alum are used; such as in preparing the white sheep leather twelve, fourteen, and sometimes eighteen pounds of alum are used for the bath containing 100 skins, with the addition of common salt, and in the case of calf and lamb skins with their hair and wool on, the bath is stronger. One pound of alum and one pound of salt are required for a single calf skin, and the leather of Hungary is made by impregnating strong hides with alum, common salt, and suet, and in the colouring of morocco leather the puce colour is communicated by logwood with a little alum. When alum is added to tallow, it makes the tallow harder. Printers' cushions and the blocks used in the calico manufactory are rubbed with burnt alum to remove any greasiness which might prevent the ink or colour from sticking. Alum is used in medicine, and also for domestic purposes, for water can be purified by means of it; the mud that water holds in suspension collects on the addition of 0·001 parts of alum (this is equal to seven grains per gallon) in long thick streaks, coagulates as it were, and is immediately precipitated. This process, the principle of which is inexplicable, was first introduced by the Chinese, and has been imitated in various parts of the world. The operation was well known from a very early period in the Highlands of Scotland, according to Dr. Clark, where it is practised with reference to peat water. The Parisian laundresses use it, but it has not been introduced into any of the establishments for the purification of drinking water, partly because alum is a substance never naturally combined in water, and may be received as a real impurity, and partly on account of public prejudice—(Richardson). In bottling fruits for preservation alum water is used. A novel application of the use of alum is seen in the lining of Milner's iron safes; he uses a mixture of alum and sulphate of lime; this makes a capital mixture for such a purpose, as the alum contains twenty-four equivalents of water; when the safe is heated, it keeps the sides cool from the evaporation of the water, thus the contents of the safe remain uninjured. There is no doubt but that alum is largely used in the process of adulteration, every one knows that it is used in the manufacture of bread; it causes the bread to be whiter than it otherwise would be. According to Liebig it is very injurious, as he supposes the soluble phosphate to combine with the alumina, forming insoluble salts, and the beneficial action is lost to the system. Some have defended the use of alum in bread, because the water was alkaline; but when we have such high authority that it is hurtful to the body, all who have the power should try to prevent its being used for such a purpose. The use of it in bread is prohibited by law under certain penalties, but the law is rarely enforced. In the manufacture of lard alum is used as an adulterant. Dr. Hassall says that alum is generally put into the vat in breweries, as it gives the beer a smack of age; it also gives a heading to the porter which landlords are so anxious to raise to gratify their customers; also in the adulteration of gin alum dissolved in water is used, and in the case of artificial port wine, alum is added to increase the brilliancy of its colour.

From the foregoing we see that there is a pretty brisk demand for this important salt. Mr. Spence has now become the largest manufacturer in the world, for he makes nearly 7000 tons a year. A few years back the quantity he turned out was a little over 1000 tons, but owing chiefly to the large amount of mechanical skill and chemical science he possessed, he was enabled to raise seven times the quantity he did before. Not only in alum has he made such improvements, but in many other things, for he has now solved the long-vexed question of the abatement of the copper smoke of Swansea.

PROCEEDINGS OF SOCIETIES.

SOCIETY OF ARTS.

CANTOR LECTURES.

"On some of the most important Chemical Discoveries made within the last Two Years."

By Dr. F. Crace Calvert, *F.R.S., F.C.S.*

Lecture I.

Tuesday, April 4, 1865.

(Concluded from page 212.)

Now, let us return to the subject under consideration, viz., that a spectrum is produced by the decomposition of light when it is refracted at an angle of 60°; and that the result of that decomposition is the production of three primary and four binary or complementary colours. Further, that the red portion of the spectrum represents calorific rays of light; that the green and yellow represent light-giving rays, and violet and the rays beyond it the chemical or actinic rays of the same. Philosophers have for a long period been able to measure accurately the intensity of the heat-giving rays, by means of a thermometer or the thermo-electric pile; and though we had a general knowledge of the intensity of the chemical rays of light, still we had no method of accurately measuring its real intensity, and conveying our results and observations to others, till Profs. Bunsen and Roscoe filled up this important gap. These gentlemen's researches will be of great service to science and to society, as they will throw much light on many meteorological data, and enable a chemist to study with more precision than has been previously done the chemical phenomena of vegetation and other phenomena connected with the chemistry of agriculture. For, example, the thermometric observations giving the mean monthly or yearly temperature of a country, by no means yield all the data required for the estimation of the true climatology of the place, or of its plant or animal producing capabilities. For these purposes we require to have not only the amount of solar heat directly or indirectly reaching the spot, but likewise the amount of chemical active solar light which may be present there. This is strikingly exemplified by the following example given by Dr. Roscoe on a comparison of the mean annual temperature between Thorshawn, north latitude, 62° 2′; west longitude, 6° 46″; temperature, 45° 6′; and Carlisle, north latitude, 54° 55′; west longitude, 2° 58″; temperature, 46·9°; difference, 1·3. From these figures it will be seen that the mean annual temperature is nearly equal, but the quantity of sunlight falling upon those two places differs most widely, and we have a corresponding difference in true climatological results. Thus the flora of the Faroe Islands and the Shetland Islands is of a most limited description. Only hardy varieties of shrubs, and no trees or flowers, exist there, while at Carlisle we have a luxuriant vegetation accompanying a most sunny sky. How essential, then, are the rays of light to vegetation. These gentlemen have also ascertained that those rays are in ratio with the intensity of that light; and still further they are also in ratio with the chemical or actinic rays of the sun; and thus the researches of these *savants* will enable them to measure with accuracy those chemical actions. It is impossible, in a lecture like this, to render justice to their researches, therefore I must refer those who wish to consult them to the *Philosophical Transactions* of the Royal Society. Still I may state that these gentlemen's photochemical instruments are based on the following data, namely, that equal intensity of light produces in the same given space of time equal shades of tint on surfaces prepared with chloride of silver of uniform sensitiveness. Thus it is shown by experiments that a tint attained by paper so prepared is constant when the quantity of light falling upon it also remains constant. Light of an intensity of 50° falling upon a paper for the time of one minute produces the same blackening effect as light of the intensity of one falling upon it for the time of fifty minutes. Knowing these laws which regulate the degree of shade of the paper, and having a surface of a perfectly constant degree of sensitiveness, it is easy to obtain the absolute measurement of the chemical action of light.

The next discovery to which I desire to draw your attention is still in its infancy; but I am induced to refer to it from two considerations. The first, that it may render great service to society by enabling us to preserve the lives of many thousands of our fellow-creatures in our coal-mines and other underground works, and also because it is a beautiful illustration of the amount of knowledge that a man requires at the present day either to understand or appreciate fully the discoveries of others, or to enable him to attempt any original invention of his own. Unless a person possesses the rudiments of the leading sciences of the day he will never be anything but an imitator, and will never succeed in improving the inventions already made. It is certainly most interesting to witness how the most abstruse branches of science are brought to bear on arts and manufactures, and no better example can be given than the application of electricity under various forms to what is commonly called the telegraph. The invention which I am now about to bring to your notice is due to M. Dumas, a young French engineer, and to M. Brequet, of Paris, who is also practically connected with telegraphy. To enable these gentlemen to carry out their discovery, they have had to study, and be perfectly acquainted with, the researches of many of the most eminent men that science has produced during the last half century. Thus they only employ the galvanic battery which was discovered by Galvani, and perfected by many philosophers, until brought at last to its present perfection. They use a mixture of bichromate of potash and sulphuric acid in a Bunsen battery. They have also had recourse to magneto-electricity, first discovered by Faraday, and brought to its present perfection by the researches of MM. Nobili, Mason, Becquerel, Joule, and others; and to enable them to construct their apparatus they have applied, with great ingenuity, the induction coil, the result of many successive discoveries, and brought to great perfection by Ruhmkorff, the vibrating interrupter of Dancer, and also the condenser of Fiquier. Further, they must have had the knowledge of the stratified light and the application of it by Gassiot: the fluorescence of light by Stokes and Becquerel, and their applications to glass by Geissler. All these facts prove the correctness of my statement, how vast is the amount of knowledge required to make a little discovery. The apparatus invented by these gentlemen is portable, for a miner carries on his back the above-mentioned galvanic battery, and this generates the force required, which is multiplied, increased, and brought to light by the Ruhmkorff coil, which is also confined in the same leather case, occupying only six inches; the magneto-electricity passes through wires covered by vulcanised india-rubber, and these are in connection with a thick glass tube, in which a vacuum has been made, and this contains a fluorescent tube of Geissler, which becomes luminous or fluorescent by the passage of the electricity through it, generated by the coil and the battery.

Although both light and electricity are most interesting subjects, and could well be made the subject of many lectures, still I am bound to leave them on one side, and draw your attention to other facts deserving of notice. It is well known to all chemists and philosophers that matter has a great tendency to assume a geometrical or crystalline form, and that whenever the atoms of matter are sufficiently free for molecular attraction to have its full influences attraction between the atoms takes place, and gives birth to well-defined crystals. The following examples can be cited:—The slow condensation of the vapour of iodine, which gives rise to well-defined crystals as well as those of camphor and other volatile bodies. When sulphur, bismuth, and other substances are melted, and allowed to cool slowly, and the excess of the fluid remaining among the crystals is poured off, well-defined crystals are found to exist in the mass, which apparently would have disappeared had not the excess of fluids been poured off, for in this case the molecules of the remaining fluid mass would have solidified among the crystals, and would have prevented the observer from seeing that the molecules when freed in the fused mass had assumed a crystalline form. The tendency of molecules to assume a geometrical form presents in many instances curious phenomena. Thus, for example, a vessel may contain acetic and carbolic acids; and if, say at a temperature of 40° or 50°, a crystal of either of those substances is placed in contact with its own fluid, the entire bulk of fluid passes in a few seconds into a solid crystalline mass. The manifestation of that force is also beautifully illustrated in the following instance:—If a tin plate be heated to a moderate temperature, and a drop of water be allowed to fall on its surface, and the plate be dipped for a few minutes into weak muriatic acid, it will be observed that the whole surface of the plate is affected, and that where the water fell it has assumed a most beautifully waved and iridescent surface. If this surface be examined under the microscope, it will be found that under the influence of the vibrations generated by the cold fluid falling upon the heated plate the mass of molecules have passed from their amorphous condition to that of a crystallised one. We all know this alteration in the tin-plate surface was particularly applied many years ago to produce variegated surfaces on our tea-trays and other similar domestic vessels. It should also be stated that this effect was greatly enhanced by the skilful application of coloured varnishes, which increased the value of the mercantile article. This discovery, which is due to an eminent chemist of the name of Prout, clearly proves, as those before cited, the power which matter has to assume a crystalline form. I cannot, however, refrain from adding the following instances, in which the mere vibration of particles of matter is sufficient to change amorphous bodies into crystalline ones. The first is that which often takes place in the iron used on railways. The most striking example is that of the iron links used to unite waggons, where it is found that the fibrous, tenacious link made of malleable iron is transformed into a crystallised, brittle link by the constant vibration it is subjected to by railway traffic. Another example is that shown by the peculiar action exercised by intense cold on the molecular state of iron, as shown by the brittleness of the metal in Russia and other cold climates; this was the case in December, 1859, in England, when, as will be remembered with regret, many railway accidents occurred, owing to the rails becoming crystallised and brittle.

The power which molecules have to assume a crystalline form has recently been the study of Mr. F. Kulhmann, an eminent chemist, of Lille, and he has given to that force the name "crystallogenic." I shall endeavour to lay before you a short epitome of his researches, which are not only interesting in a scientific point of view, but also in consequence of the mode in which he has applied it in connection with arts and manufactures; and those who take an especial interest in the matter will read with pleasure his researches in the *Comptes-Rendus de l'Academie des Sciences de Paris.* M. Kulhmann, having mixed a certain class of substances which crystallised with facility such as mannite, sulphate of zinc, iron, copper, with a thick solution of gum, or any other substances interfering with the free crystallisation of these substances, and having spread the mixtures on glass, he found, by exposing such prepared plates to the atmosphere, that gradually the water would evaporate, leaving a dry mass, in which could be observed most beautiful arborisations. Each of the solutions will produce a well-defined design, which is not always identical, although operating under the same circumstances. Still, they assume very similar forms, being in some instances that of stars, and in others that of leaves and wreaths. These modifications are obtained by the strength of the solution, the nature of the salt, and the mode of preparation. Kuhlmann further observed, that if amorphous substances, such as magnesia and sesquioxide of iron, or chromium, be mixed with bodies susceptible of crystallisation, and these added to a gummy fluid, the amorphous particles are drawn into the crystallising substances, and follow the outlines; and if these are produced on surfaces, such as those of glass or porcelain, and heat applied, the gummy matter will be destroyed or volatilised, and the crystalline medium and the amorphous substances become incorporated, and fixed in the porcelain, reproducing on its surface a crystallogenic design. These researches which I have the pleasure to lay before you will show you the probability of carrying out these results to a satisfactory issue. Of course, the glass or porcelain manufacturer will easily understand that he will have to use borax or phosphate of soda, or other flux, as a crystallising medium, if he wants to produce in his art the results that I have stated. M. Kuhlmann has applied his crystallogenic process with great success to photography, and also to the art of engraving metals. As the latter may have some interest, I will give you an outline of his process. It consists in producing a crystallogenic design on the surface of an iron or copper plate, and then applying on the so-prepared surface—say a sheet of lead or copper—and submitting them to high pressure when the design would be impressed upon the plate. The embossed plates, by being placed in a prepared solution, and in connexion with a galvanic current, will easily give birth to a *fac-simile* in relief, which can be used as a printing surface. It is with pleasure that I am able to state that though I part with these interesting researches for the present, I shall have the satisfaction of referring to them again in a subsequent part of this course of lectures, when I shall speak of some researches of this gentleman which have a more immediate bearing on the progress of science.

It has been for a long time a disputed question whether the stained windows we all admire in old cathedrals could be restored in such a way as to resume the brilliancy they had at the time they were placed there by the artists. At all events there is now no doubt that this can be effected by the process discovered by my eminent master, M. E. Chevreul, as is proved by the application of it in connexion with the restoration of stained windows existing in a well-known church in Paris—that from which the tocsin of St. Bartholomew was sounded, "St. Germain des Près." The process devised by M. Chevreul is highly practical; it consists in removing the stained glass from the windows, and dipping it for several days, first, in a weak solution of carbonate of soda of a specific gravity of 1·068, then washing it, and dipping it for several hours in a solution of muriatic acid of a specific gravity of 1·080. On the glass being washed and dried, it will be found as brilliant and beautiful as when it came from the hand of the manufacturer. M. Chevreul has found that the dim and dirty appearance which stained glass assumes by time is due, especially in large towns, to the various products of smoke being first condensed on the glass by fog and rain, and then becoming oxidised, they act as a cement to various mineral matters, such as chalk, gypsum, oxide of iron, &c., which help to impoverish the transparency of the glass. The alkali acts upon the organic matter and dissolves it, while the muriatic acid removes the minerals. The durability of glass placed in our monuments is extraordinary, when we bear in mind the curious results published some years since by the eminent chemist Pelouze, who observed that when window, bottle, and other varieties of glass were reduced to a fine powder, and mixed with water, they were soon acted on, yielding a large quantity of silicate of soda to that fluid, amounting in several cases to 8 or 10 per cent. in cold water, and even to 36 per cent. when the finely-pulverised glass was boiled in water; and that, in many cases, it was a definite compound which was dissolved from the glass—namely, a silicate of soda, composed of three equivalents of silica and two equivalents of soda. M. Pelouze explains the extraordinary difference in the effect which water produces on glass when in large masses or plates, as compared with its influence on the same substance when reduced into a fine state of powder, by assuming that, in the first instance, water does not act because it seldom remains sufficiently long in contact with the glass to act upon the elements which compose it; while, in the second case, there exist numerous points of contact between the fluid and the solid body, thus facilitating the action of the fluid on the solid material. I am inclined to think that the peculiar molecular condition the surface of glass assumes, when manufactured in plates or otherwise, must exercise a great influence on the property which glass has to resist the action of water. If it were not so, how could be explained the limited action which watery fluids, such as wine, cause upon the interior surface of a bottle, though they remain in contact for many years? I can conceive glass assuming a peculiar surface by the pressure of the atmosphere, thereby producing a homogeneous one susceptible of resisting the action of water. A similar instance occurs in the case of polished steel, or of the rolled surface of wrought iron, or the skin of cast iron, which resist the chemical action of either air or acids in a far greater degree than does the interior of the substances which compose these metallic bodies.

Whilst dwelling upon old materials, you will allow me to give you an outline of a process devised by M. Stahl for the preservation of antediluvian fossils. We are aware how interesting it is to preserve relics of past ages, giving us some of the conditions of the world at various periods. Those relics are exceedingly fragile, and after many clumsy attempts M. Stahl arrived at his discovery. If the fossil is compact and comparatively firm, it is saturated by means of a brush with melted spermaceti; but if is friable, it is necessary to employ a melted mass composed of four parts of spermaceti and one of colophany resin, which in cooling gives great solidity to the mass of the fossil.

I would, in conclusion, draw the special attention of all artists who take an interest in the decorative art to the interesting papers published recently by M. Onfroy, on the one hand, and M. Wiel, of Paris, on the other; the first being in the *Technologiste* of last year, the latter in the *Annales de Chemie et de Physique*, on their respective methods for covering a metal with another more valuable by its properties or precious by its qualities. These methods have a special reference to cast iron or wrought iron. In Paris these processes, which may be regarded as not only ornamental but useful, have been applied with great success. Thus, for example, instead of the dirty, pitchy black lamp-posts which ornament our English towns, there can be seen in Paris elegant, well-designed, bronze-like posts, which are pleasing to the eye. The same can be said of the fountains on the Boulevard Sebastopol, the Place de la Concorde, and many other public promenades in Paris, which excite the admiration of foreigners visiting that city.

ACADEMY OF SCIENCES.

November 6, 1865.

The *Comptes Rendus* of the Academy is again about half-filled with communications on cholera. With the strictly medical papers we have nothing to do, but we notice the memoir of M. Baudrimont (*Experimental Researches on Epidemic Cholera*), who thus sums up the conclusions he has come to on the subject:—In cholera, he says, the blood is profoundly altered; it undergoes a loss of serum, represented by water, albumen, and various salts. The other elements lose the property of forming a clot. The albumen becomes transformed into a sort of diastase, which liquefies starch paste. This diastase is found in the stools. The mucoid matter is pretty much what it has been described by Audral; but to his description must be added spherical globules, like those which constitute beer yeast. To these observations we may add some speculations of the author. He asks whether the great resemblance between the dejections and the pancreatic juice may not indicate an excessive secretion of this fluid, and that it is by Wirsung's duct that all these fluids and the matters they hold in solution reach the intestine? And the change in the albumen and its transformation into diastase, may not this be the result of fermentation, and, if so, lead to new therapeutic and prophylactic measures? Might not antiseptic agents prevent the change or arrest it after having commenced? Bicarbonate of soda, in combination with ammonia, the author believes to be the best remedy for cholera.

MM. Friedel and Crafts presented a memoir "*On a New Alcohol in which a Part of the Carbon is Replaced by Silicium.*" Stannic biethide, Frankland has shown, will exchange one or more molecules of ethyl for as many atoms of iodine or chlorine. Silicium ethyl behaves very differently from the organo-metallic compounds, and comports itself very like saturated hydrocarbons. When a current of chlorine is passed into cooled silicium ethyl the liquid at first becomes yellow, and then suddenly decolorises, evolving chlorhydric acid. No chloride of ethyl is set free. If the operation is stopped in a short time, and the products submitted to fractional distillation, and then the part boiling below 160° is again treated with chlorine, we obtain by repeating these operations several times a notable quantity of chlorinated products, boiling principally between 180° and 220°. The authors hoped to easily isolate from this mixture mono-chlorinated silicium ethyl. They did, in fact, after a great number of distillations, obtain a small quantity of liquid boiling about 185°, which had a composition answering to the formula $SiC_8H_{19}Cl$. The greater part of the product, however, passed between 190° and 195°, and was a mixture in equal equivalents of mono- and bichlorinated silicium ethyl. The portions distilling at a still higher temperature approached the bichlorinated compound. At 230° it was necessary to stop the distillation, as the liquid in the flask began to decompose. Finding the difficulty of separating the chlorides formed, the authors proceeded to transform them into other products which could be more easily separated. After long attempts they succeeded in isolating two compounds derived from monochlorinated silicium ethyl. They heated portions of the product boiling between 180° and 200° in sealed tubes with acetate of potash and alcohol. Bichlorinated silicium ethyl was attacked first; and if the temperature did not exceed 130° or 140° the monochlorinated compound could be separated from the products of the reaction. For this the contents of the tube were added to a good deal of water; an oily liquid separated, which was washed once or twice with water and then treated with concentrated sulphuric acid. Silicium ethyl and the chlorine derivatives are insoluble in that acid, while the acid which might have been formed, and the oxide of silicium triethyl,

$$\left.\begin{matrix} Si(C_2H_5)_3 \\ Si(C_2H_5)_3 \end{matrix}\right\} \Theta$$

arising from the action of acetate of potash upon bichlorinated silicum ethyl are soluble. The insoluble part was separated by decantation washed and distilled. That part distilling between 180° and 190° was heated again in a tube with alcohol and acetate of potash, this time to 180°, for some hours. The tube now contained a deposit of chloride of potassium. The product was separated as before with water, treated with sulphuric acid to get rid of unacted on chloride; the sulphuric solution carefully decanted and poured into enough water to prevent a great rise of temperature. A liquid separated which boiled from 208° to 214°; it possessed a slight etherial and acetic odour, and burnt with a luminous flame, scattering white fumes of silica. It was monochlorinated silicium ethyl in which the chlorine was replaced by the monatomic residue oxacetyle, or rather an acetic ether in which the residue SiC_8H_{19} played the part of a monatomic radical,—

$$\left.\begin{matrix} SiC_8H_{19} \\ C_2H_3\Theta \end{matrix}\right\} \Theta$$

On treating this product at 120° to 130° with a solution of potash in dilute alcohol it was transformed into a liquid having a camphorous odour, insoluble in water, and boiling at about 190°. The composition of this product answers to the formula,—

$$\left.\begin{matrix} SiC_8H_{19} \\ H \end{matrix}\right\} \Theta$$

It is the hydrate corresponding to the acetate employed. Sodium dissolves in it, disengaging hydrogen, and giving rise to the formation of a gelatinous matter which is decomposed by water, so reproducing the original compound, the water becoming alkaline.

All these facts, the authors say, reveal a striking analogy between silicium ethyl and the saturated hydrocarbides of the series C_nH_{2n+2}. The atom of silicium in the former body functions exactly like an atom of carbon, and seems to be retained with an energy comparable to that which binds the atoms of carbon themselves. To separate this silicium, as also to break the fundamental chain of the hydrocarbides, nothing less than energetic oxidising actions will suffice. It is then pointed out that the number of hydrogen atoms in silicium ethyl is the same as there would be in hydride of nonyl; that is to say, a saturated hydrocarbon containing the same number of tetratomic atoms, $SiC_8H_{20} = Si(C_2H_4)_4$, $C_9H_{20} = C(C_2H_5)_6$. In conclusion, the authors say that the numerical resemblances and the parallelism of reactions of silicium ethyl and its monochlorinated derivative with those of the hydrides described by Pelouze and Cahours justify them in designating the new alcohol and acetate as the *hydrate* and *acetate of silico-nonyl.*

M. E. Kopp presented another note "*On the Theory of the Formation of Soda by Leblanc's Process.*" It is in reply to M. Scheurer Kestner, and the author gives several analyses to prove that the relation of sulphide of calcium to quick-lime, in soda-waste, is always such as to indicate the combination 2CaS,CaO, the oxysulphide of calcium of Dumas.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Physical and Mathematical Section.

October 12, 1865.

Robert Worthington, F.R.A.S., *Vice-President of the Section, in the Chair.*

Mr. Dancer, F.R.A.S., exhibited a small and cheap, but very effective, induction coil, and a set of four Geissler' tubes, in which the stratification of the electrical light wa very distinctly shown when a small battery of only one pair of elements was employed to produce the primary current.

Mr. BROTHERS, F.R.A.S., exhibited a beautiful series of enlarged photographs of the moon from negatives taken during the progress of the lunar eclipse on the night of the 4th ult.

Mr. DANCER stated, with reference to the eclipse, that he and his son, Mr. James Dancer, had noticed some irregularities on the border of the earth's shadows, which, as they maintained their forms and relative positions whilst the shadow passed over the moon's disc, could not, he thought, be due to differences in the reflective power of different portions of the moon's surface.

Mr. BAXENDELL suggested that these irregularities might be owing to the prevalence of extended masses of clouds in certain portions of the earth's atmosphere, and their absence in others.

MICROSCOPICAL SECTION.

October 16, 1865.

A. G. LATHAM, *Esq., President of the Section, in the Chair.*

THIS being the first meeting of the Session, the PRESIDENT delivered an address reviewing the past proceedings of the Section, and referring with satisfaction to the proposal to extend its objects to subjects of Natural History generally.

Mr. SIDEBOTHAM read "*Notes on Atlantic Soundings.*" He said that in the unsuccessful attempt made to raise the Atlantic cable after it had unfortunately parted, the ropes and grapnels brought up from the bottom small portions of ooze or mud, some of which was scraped off and preserved, as stated at the time in the newspapers. Believing that a careful examination of this deposit might prove of considerable interest, he wrote on the subject to Dr. Fairbairn, who, after considerable trouble, obtained for him a fine sample, mounted specimens of which he now presented for the cabinet, and to each member of the Section. In appearance the deposit resembles dirty clay, and under the microscope reminds one much of the chalk from Dover, indeed, it has all the appearance of being a bed of chalk in process of formation. It is composed entirely of organisms, chiefly in fragments. In the short examination he had made, he observed several forms which gave promise of interesting results, and he thought it would be desirable to frame a complete list of the species found, which would be best accomplished by two or three members taking temporary possession of all the slides, and preparing a report on their united observations. The sample now distributed was obtained at Dr. Fairbairn's request by Mr. Saward, from Mr. Temple, one of the engineering staff, who states that it was got in grappling for the cable, August 11, 1865, lat. 51° 25′ 15″ N., long. 38° 59′ W.

NOTICES OF BOOKS.

Saint Bartholomew's Hospital Reports. Edited by Dr. EDWARDS and Mr. CALLENDER. Vol. I. London: Longmans and Co. 1865.

Clinical Lectures and Reports. By the Medical and Surgical Staff of the London Hospital. Vol. II. London: Churchill and Sons. 1865.

WE have already given an account of some of the cases of poisoning by nitrobenzole which have occurred—and they have been very few—so that it will be unnecessary here to do more than refer to some of the chief peculiarities of the action of this poison. For a long time after it became an article of commerce, nitrobenzole was not known to be poisonous. Some of it was exhibited as a new product in the Perfumery Department of the Exhibition of 1851, and the Jury of that section, reporting thereon, said that it was "probably capable of application in confectionery and cookery, as its flavour resembles that of bitter almonds, without containing any prussic acid." It was first shown to be a poison in 1856, but before that time the stupefying effects of its fumes had been noticed by workmen employed in its manufacture.

The first case of poisoning in the human subject occurred in 1860, and was investigated by the author of the paper we notice. A workman spilt some of the liquid upon the front of his clothes, and thus went about breathing an atmosphere charged with the vapour. In the course of four or five hours the man began to feel ill, and in nine hours he died. In all the other cases recorded (only five) some of the liquid has been swallowed, but in none, probably, more than a few drops. All the cases, with one exception, have proved fatal.

With regard to the symptoms, we need only say that they are those of a powerful narcotic poison. The patient, in general, at first becomes drowsy, some convulsions afterwards occur, profound coma gradually comes on, and the sufferer dies.

An investigation of the effects of the poison on animals led to some interesting observations. The most curious and, indeed, startling of these is the circumstance that when but a small dose of the poison is administered, the effects are not developed until the lapse of a considerable time,—in some cases three or four days. Some discomfort which the animal seems to feel at first passes off, and it remains to all appearance perfectly well until seized with a kind of epileptic attack. Paralysis of the hinder extremities succeeds, which is followed by severer symptoms, and the animal dies, it may be as long as nine days after having swallowed the poison.

When death is rapid, the smell of nitrobenzole is perceptible in every tissue of the animal's body; but in lingering cases no vestige of the smell remains. It has been found, in fact, that the nitrobenzole becomes changed into aniline in the living body—a most important fact, as Dr. Letheby remarks, to the toxicologist, the chemist, and the physiologist.

The effects of aniline are closely analogous to those of nitrobenzole; but the symptoms do not seem to be delayed, as in the case of the latter poison. On this point, however, we cannot speak with certainty, for Dr. Letheby appears to have administered aniline in rather large doses.

It is a remarkable and, so far as our memory serves us, an unique circumstance, that while aniline itself is an energetic poison, its salts are quite innoxious. The sulphate has been administered in large doses—in one case at the London Hospital nearly an ounce was given to a patient in the course of a few days—and the only effect observed was a colouration of the skin, gums, and nails, which all became more or less purple.

We have seen before that nitrobenzole is converted in the body into aniline, and the effects of aniline just described appear to show that aniline is also converted into some of its coloured derivatives.

"The chemist perceives that the nitrobenzole has been changed, by a process of reduction, into aniline, that it has lost its four proportions of oxygen, and has gained two of hydrogen, passing from $C_{12}H_5NO_4$ to $C_{12}H_7N$, and he also perceives in the leaden hue of the face and the *mauve* tint of the lips and nails that a subsequent oxidation of the aniline has been effected. The physiologist recognises the fact that these changes have occurred in different parts of the body, that the process of reduction has taken place in the interior of the system, and that the subsequent oxidation has been merely a surface effect." However this may be, these curious facts seem to throw some light on the processes going on in our bodies, and suggests investigations from which further information may be obtained. The mauve colouration speedily disappears from the surface of the body: in what form is the aniline compound eliminated?

We have already given Dr. Letheby's process for the detection of aniline and nitrobenzol in organic matters, and need now describe it very briefly.

The matters to be examined are bruised in a mortar with a little water, slightly acidulated with sulphuric acid, and then submitted to distillation. Unchanged nitrobenzol passes over, and may be recognised by its smell. The residue in the retort is treated with strong alcohol to extract sulphate of aniline. The alcoholic solution is treated with slight excess of subacetate of lead to remove organic matters, and excess of lead is got rid of by treating the filtered solution with sulphate of soda. The filtered solution from sulphate of lead is now made alkaline with caustic potash, and distilled to dryness in an oil bath. Aniline is found in the distillate, and may be recognised by the nascent oxygen taste described in a previous number of the Chemical News (vol. v., p. 71).

We now take our leave of the two volumes we notice, which, embodying the experience gained at two of our largest London hospitals, have strong claims to the attention of the medical profession.

Contributions to Blow-pipe Analysis. By E. Chapman, Ph.D., Professor of Mineralogy and Geology in University College, Toronto. Toronto: Lovell and Gibson. 1865.

This is, for the most part, a collection of articles communicated to the chemical journals during several years past, and now published as the *avant-courier* to a complete guide to blow-pipe analysis and blow-pipe assaying, which the author has in preparation and nearly ready. Two processes from the collection we notice will be found in another part of this number. We shall wait with some impatience for the author's larger work, which we expect to contain much new, original, and valuable matter.

Poggendorff's Annalen der Physik und Chemie. No. 8. 1865.
Annales de Chemie et de Physique. September, 1865.

We notice these two journals together on this occasion because they contain announcements of the same discovery made by different experimenters. *Poggendorff's Annalen*, which reached us first, contains a paper by A. Mitscherlich "*On the Application of the Spectroscope to the Detection of Chlorine, Bromine, and Iodine in the Minutest Quantities.*"

The French journal contains an article, by M. E. Diacon, entitled "*Researches on the Influence of the Electro-Negative Elements on the Spectra of Metals,*" in which the same application is pointed out. We shall give an account of both these papers in an early number, and only mention now a "preliminary announcement" by Mitscherlich, at the end of his paper, that his spectrum experiments have led him to the conclusion that almost all the metalloids are compound bodies.

Only one other chemical paper appears in *Poggendorff.* It is by Carl Ritter von Hauer, "*On a Series of Compounds of Sulphates in Fixed Equivalent Proportions.*" The author has formed a series of salts having the general formula $CuO.SO_3 + 2(RO.SO_3) + 21aq$. The sulphates which lend themselves to this combination with sulphate of copper are those of cobalt, nickel, magnesia, zinc, and iron. The nickel and cobalt salts are perfectly isomorphous. The crystals of all the compounds have a great resemblance in form to that of sulphate of copper without being strictly isomorphous.

In the *Annales de Chemie et de Physique* will be found two important electrical papers by M. Gaugain, "*On the Development of Electricity which Results from the Friction of Metals and Insulating Bodies,*" and "*On the Single Origin of Electromotive Forces.*" The author believes that electricity in all cases results from the contact of two molecules of different natures. "The electricity developed in thermo-electric and hydro-electric couples, as well as that produced by friction, results from a molecular force, which is manifested whenever two molecules of different natures are placed in contact. This force is, without doubt, affinity; but it must be remarked, however, that if, in certain cases, it produces at the same time electricity and chemical combination, it produces in other cases electricity alone."

There is another important paper by M. Leroux, "*On the Laws of the Disengagement of Heat by the Passage of the Electric Current in Metallic Conductors and Voltameters,*" which gives a simple method of determining the heat disengaged in electro-chemical decompositions.

Two papers, or rather abstracts of memoirs, by M. Dufour are given:—1. "*On the Ebullition of Water, and on a Probable Cause of Boiler Explosions;*" 2. "*On some Facts relating to the Ebullition of Water.*" We shall give the author's explanation of the cause of boiler explosions in a miscellaneous paragraph.

M. Marguerette's memoir "*On Acieration,*" or steelification, to use the clumsy English equivalent, and M. Semenoff's paper "*On the Law of Volumes in Double Decomposition,*" both of which we have already noticed, complete an unusually valuable number of the *Annales.*

Annalen der Chemie und Pharmacie. October, 1865.

This journal, among several papers which we have already noticed in other periodicals, contains several short papers of great interest. We publish to-day in another place a striking "*Lecture Experiment,*" by Kraut. Besides this we have a short paper "*On the Conversion of Benzol into Hexyl,*" by Carius; another "*On the Decomposibility of Hydrochloric Acid by Copper,*" by Weltzien; a description of "*An Apparatus for the Production of Phosphoric Anhydride,*" by Graf Grabowski; and a preliminary notice of "*Methoxysalylic Acid,*" by Carl Graebe.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

1766. J. Dale and R. S. Dale, B.A., Manchester, "Improvements in the production of pigments suitable for printing upon paper and woven fabrics.—Petition recorded July 4, 1865.

2465. A. V. Newton, Chancery Lane, "An improved mode of decarbonising retorts." A communication from G. W. Edge, Jersey, New Jersey, U.S.A.—Sept. 26, 1865.

2564. J. Holliday, Huddersfield, "Improvements in preparing violet, blue, and red colouring matters."—October 6, 1865.

2720. A. Bankart, Braughing, Hertfordshire, "An improved apparatus for calcining copper ore, and for treating the products of copper ore when being calcined."

2721. W. H. Kitchen, Newcastle-on-Tyne, "A new or improved apparatus for producing artificial respiration." —October 21, 1865.

2754. W. E. Newton, Chancery Lane, "Improvements in the preparation of photographic papers." A communication from L. de Montgolfier, Rue St. Sebastien, Paris. —October 25, 1865.

2791. R. D. Dwyer, Liverpool, "An improved coating for covering the bottoms of iron and steel ships and other navigable vessels and marine works, to prevent oxidation and the adhesion of animal and vegetable matter thereto."

2793. E. Meldrum, Bathgate, county of Linlithgow, "Improvements in the distillation of coal and shale, and in the apparatus employed therein."—October 30, 1865.

2801. G. Robinson, M.D., Welbeck Street, Cavendish Square, "Improvements in the manufacture of caustic soda."

2803. R. Cassels, Glasgow, N.B., and T. Morton, Motherwell Iron Works, Lanarkshire, N.B., "Improvements in furnaces."—October 31, 1865.

INVENTION PROTECTED BY THE DEPOSIT OF A COMPLETE SPECIFICATION.

2872. G. A. Jasper, Mid., Mass., U.S.A., "Having reference to the cleansing or bleaching of sugar, which invention may also be applicable to other purposes of like character."—Recorded November 7, 1865.

NOTICES TO PROCEED.

1700. M. Ashby, Staines, Middlesex, "An improved brewers' and distillers' refrigerator, or apparatus for cooling liquids, condensing steam or other vapours."—Petition recorded, June 26, 1865.

1716. H. G. Fairburn, St. Luke's, Middlesex, "An improved mode of combining and forming small coal or coal dust into lumps, blocks, or otherwise, to be employed for the purposes of fuel."—June 28, 1865.

1737. W. Schofield, Heywood, Lancashire, "Improvements in the manufacture of gas retorts and other articles made of fire-clay, and in furnaces for burning the same, and for other purposes."—June 30, 1865.

1770. R. A. Brooman, Fleet Street, "A new or improved method of dissolving pitch." A communication from F. C. Armelin, Paris.—July 4, 1865.

1795. A. F. Morelle, Boulevart Sébastopol, Paris, "An improved portable pocket gas generator, or gazogene."—July 7, 1865.

2296. J. Dawson, Greenock, N.B., "Improvements in supplying charcoal to sugar decolorising vessels, and in apparatus therefor."—Sept. 7, 1865.

2585. H. A. Bonneville, Rue du Mont Thabor, Paris, "Improvements in apparatus for preparing skins for tanning, and for currying or dressing the same." A communication from P. Dumas, Roaune, France.—Oct. 7, 1865.

2643. W. H. G. Jones, Crosby-square, London, "Improvements in machinery employed for crushing, amalgamating, and washing gold quartz and other minerals, or matters containing gold or other metal." A communication from J. Hart, Melbourne, Victoria.—Oct. 13, 1865.

CORRESPONDENCE.

Utilisation of Chlorine Residues and Soda Waste.

To the Editor of the CHEMICAL NEWS.

SIR,—In reference to the notice which appeared in No. 306, and a letter from M. Kopp in No. 309 of the CHEMICAL NEWS on the "Utilisation of Soda Waste," allow me to say a few words.

You will receive by same post specifications describing the processes patented by Mr. Townsend and me; and as you have indicated your intention of again bringing the subject under review, your kind perusal will be esteemed.

I have much pleasure in corroborating some of M. Kopp's remarks on this subject. When he says that all the processes hitherto employed extend only to the partial utilisation of the residues, I perfectly agree with him, and I can bear testimony to the fact which he puts on record of sulphuretted hydrogen affecting the eyes of workmen exposed to its influence. I have seen men rendered quite blind, and have to be led home. They always recovered, however, in a day or two, and were never so subject to a second attack when they resumed the same work.

I am rather surprised, however, that M. Kopp should give Mr. Townsend and me credit for processes which are not described in the specification.

The first proposition he admits to be practicable, and he has described it correctly. The second proposition he says is impracticable; but we never proposed the process which he describes, as you will see from the specification. The third proposition he also condemns; but he has misquoted it still more erroneously.

The processes which he proposes to adopt are precisely those described by Mr. Townsend and myself. He, however, makes an important addition—viz., that of utilising the sulphuretted hydrogen evolved. There is, however, a little stumbling-block which will puzzle chemists to remove, and that is the peculiar property of MnS to become converted into $MnOSO_3$ on ignition. Had not this difficulty intervened, the process would have been a grand success, as the sulphur would be effectually recovered, and the residue, as sesquioxide of manganese, could be used over again for the manufacture of chlorine. It looks beautiful until this difficulty is discovered. The precipitate burns well, sulphurous acid comes off strongly, and the residue appears exhausted; but examine it, and behold it contains a large proportion of sulphur still in the form of sulphate of manganese.

That portion of the precipitate which consists of free sulphur and sulphide of iron is completely exhausted of sulphur on ignition, and also a small proportion of the sulphide of manganese; but the greater part of the latter substance acts as described, and it is well known that sulphate of manganese will bear a red heat without undergoing decomposition. Not so, however, sulphate of iron.

It is quite possible, however, that manufacturers may adopt the process even with this drawback, as both the substances used have no commercial value, and it is necessary to have them removed on sanitary grounds.

I, however, attach more importance to the processes for utilising the alkali waste as hyposulphites. When treated by the commercial rule of £ s. d., and the products reckoned at only one-half the present market value, sulphur is left far behind in the comparison. But then it may be objected that the large quantity of hyposulphites produceable would be in excess of the demand. This may be so at present; but reduce the price to one-half, and perhaps the demand would be very different. The peculiar properties possessed by hyposulphite salts will undoubtedly adapt them for new and unheard-of uses were the price low enough.

One of the specifications sent describes a process for using hyposulphite of alumina as a mordant for Turkey red dyeing. On getting the process tried some splendid results were obtained; other trials were again considered failures, but in the hands of a real practical Turkey red dyer with scientific knowledge there is no doubt about the ultimate success of it. The secret jealousy with which Turkey red processes are conducted makes it difficult for a mere chemist to obtain access to all the technical details. Should hyposulphite of alumina come to be used as indicated, the fountain-head of supply would be alkali waste, and obviously a larger quantity of hyposulphites would be required than at present. But I do not infer from this that, considerable as the increased consumption would be, it would absorb all the alkali waste produced. I merely quote it as one among a host of the numerous uses to which hyposulphites will yet be put. Several are now on their trial privately, and the results may or may not be successful.

I am, &c. JAS. WALKER.

275, St. George's Road, Glasgow, November 7.

Professor Church's New Cornish Minerals.

To the Editor of the CHEMICAL NEWS.

SIR,—With reference to the report of the proceedings of the Chemical Society's meeting of November 2, which appeared in your journal last week (p. 223), I beg leave to request that you will grant me space for the insertion of a few additional particulars relating to the interesting minerals described by Professor Church.

It appears that I was in error when stating that the crystalline form of the new cerium mineral, Churchite, had been determined by Professor W. H. Miller, of Cambridge. The truth is, that the mineral in question was submitted to this eminent authority, but Professor Miller was unable to separate a crystal from the aggregated masses in a condition fit for accurate measurement. Professor Church's own observations had led him to conclude that the crystalline form of the mineral was oblique, but his observations having been made with the inferior instrument, the microscopic goniometer, may almost be said to require confirmation—a duty which Professor Maskelyne, at the meeting, volunteered to undertake.

The hydrated phosphate of calcium and aluminium, although containing the same amount (12 per cent.) of water, is believed by Mr. Church to differ from the mineral described by M. Damour as occurring in the diamond sands of Bahia.

Lastly, with respect to the double arseniate of copper and lead, it should have been described, not as a *variety* of olivenite, but as a distinct *species* belonging to the olivenite group. I am, &c. The Reporter.

November 13.

The Past and Present History of Alum.

To the Editor of the Chemical News.

Sir,—In your last issue I find mention of my "Dictionary of Chemistry" by Mr. J. Carter Bell, F.C.S., relative to the article "Alum." Mr. Bell remarks :—"This is a most unfair description of such important alum works as Mr. Spence's are, and I am surprised to find such a statement in such a compendious dictionary as Dr. Muspratt's professes to be." Your correspondent, Mr. Bell, applies the word *professes* to a book that all the first *savans* of the world have eulogised, and which Baron Dumas, of Paris, calls "the great chemical work of the age." As it is the first and only time the information in the Dictionary has been called into question, I feel bound to notice Mr. Bell's statement, and I beg leave to say that at the time each monograph appeared, it contained "a complete exposition of the state of the chemical manufactures, with the latest and most improved processes" (*vide* Preface). Your readers must bear in mind "Alum" was written nearly fourteen years since!

Is it likely, Sir, that "Alum" should be the only incomplete article in the book? Why Mr. Bell has thought fit now, at this late date, to find fault with it is best known to himself. If I should re-write "Alum" for a "next edition of the Dictionary, a better description will be given," if *requisite*. I am, &c.

Sheridan Muspratt, M.D., Prof. of Chemistry.

College of Chemistry, November 13.

Ready Mode of Amalgamating Zinc Plates.

To the Editor of the Chemical News.

Sir,—I venture to send you a method of almost instantaneously amalgamating corroded zinc battery plates, which occurred to me recently, after some twenty years' trial of different plans; perhaps economy of time in even humble matters of detail may be worth record where the process is of repeated occurrence.

The following treatment in the case of thickly oxidised plates will yield in speed and effectiveness to few:—Place in a flat dish two ounces of common hydrochloric acid, one drachm of a saturated solution of bichloride of mercury (corrosive sublimate), and half an ounce of the latter metal; lay the zinc, without previous scouring, in the liquid mixture, and gently smear the mercury over surface of the plate with a toothbrush; the mercury will readily and thoroughly adhere to each portion of the surface as the oxide is rapidly dissolved by the HCl.

As a means of comparing speed, in seventy seconds I completely coated inside and out a cylindrical plate of forty square inch surface, whose interior was rather inaccessible and very corroded.

A set of six cylindrical cells of Groves' battery were thus, with the same materials, amalgamated, equipped, and primed for action in a quarter of an hour.

No friction is needed; the plates should be well drained from excess of mercury, lest they become brittle, though this danger is lessened by the rapidity of the process. The *rationale* of my preference for HCl and $HgCl_2$ is sufficiently obvious. I am, &c. B. W. Gibsone, F.C.S.

November 7.

MISCELLANEOUS.

The Royal Society.—The following are the officers selected for the ensuing year:—*President.*—Major-Gen. Ed. Sabine, R.A., D.C.L., LL.D. *Treasurer.*—William Allen Miller, M.D., LL.D. *Secretaries.*—William Sharpey, M.D., LL.D., George Gabriel Stokes, Esq., M.A., D.C.L. *Foreign Secretary.*—Professor William Hallows Miller, M.A. *Other Members of the Council.*—John Frederic Bateman, Esq., Lionel Smith Beale, Esq., M.B., William Bowman, Esq., Commander F. J. Owen Evans, R.N., Edward Frankland, Esq., Ph.D., Francis Galton, Esq., John Peter Gassiott, Esq., John Edward Gray, Esq., Ph.D.; Thomas Archer Hirst, Esq., Ph.D., Sir Henry Holland, Bart., M.D., D.C.L., William Odling, Esq., M.B., Sir John Rennie, Knt., Professor Warington W. Smyth, William Spottiswoode, Esq., M.A., Paul E. Count de Strzlecki, C.B., D.C.L., Vice-Chancellor Sir W. P. Wood, D.C.L.

Reaction of Metallic Thallium on a Few Solutions of Metals.—Thallium immersed in solutions of sulphate, nitrate, and acetate of copper, deposited in flakes (similar to iron) metallic copper; thallium in $AgONO_5$ deposited silver; thallium in $AuOSO_3$ deposited gold; thallium in $HgOSO_3$ (sulphate of the red oxide) deposited mercury; thallium in $PbO\bar{A}$ deposited lead. The gold appeared in flakes, partly floating and partly at bottom; mercury in small globules; lead as a crystallised mass on top of the thallium—very similar to thallium on zinc. When thallium is put into a solution of the nitrate of cobalt, the metal is covered with a blue coating, which from it becoming green on exposure to the air, appears to be similar to that basic salts of cobalt precipitate which is thrown down by KO.—*Walter C. Reid.*

Clay and Glycerine for Modelling.—We read in *Cosmos* that a mixture of clay and glycerine, which keeps its plasticity for any length of time at all temperatures, has been found very useful by modellers. The clay must be well dried before it is mixed with the glycerine. It is said that the mixture can be used in place of wax for the most delicate work.

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. *Private* letters for the Editor must be so marked.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Dr. Muspratt.—Received, with enclosures.

Jeremias.—We must decline our correspondent's last communication.

Mr. Walker.—The patents have come to hand.

Ninety-nine.—Both errors are so obvious as to correct themselves. As regards the second pointed out, it must have occurred to every reader but our acute correspondent that the decimal point was in the wrong place, and that it should have been ·56.

Books Received.—"Pereira's Manual of Materia Medica," edited by Dr. Farre.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Application of Spectrum Analysis to the Detection of Chlorine, Bromine, and Iodine, by ALEXANDER MITSCHERLICH*.

THE difficulty of recognising small amounts of chlorine, bromine, and iodine in a mixture of haloid salts is well known; and it is found impossible to detect mere traces of these bodies in such mixtures by any hitherto known method. I have, however, discovered a means of recognising the smallest amounts of these substances by the use of spectrum apparatus.

The haloid salts of copper are the most difficult to decompose by heat, and they are therefore to be preferred for spectrum investigations, which are best made in the following way:—The substance to be examined, well dried, is intimately mixed with half its weight of sulphate of ammonia and one-tenth its weight of oxide of copper. This mixture is placed in a globular enlargement of a combustion-tube, one end of which is connected with a hydrogen gasometer, the opposite end being open. A stream of hydrogen is passed through the tube, and heat gradually applied to the mixture. The hydrogen being ignited, the first appearance seen in the spectrum apparatus is a brightness in the green in which, however, no definite spectrum can be perceived; but afterwards the spectrum of the haloid salt of copper is distinctly visible.†

When present in small amount the chlorine compound is best recognised by the lines at 105 and 109, and by the brightness near 85 and 87; the bromine compound is detected by the brightness at 85, 88½, and 92; and iodide of copper by the brilliancy at 96, 99, and 102½.

By this method, and without further trouble, ¼ per cent. chlorine, ½ per cent. bromine, and 1 per cent. of iodine are easily recognised, and a practised observer may detect much smaller quantities. One disadvantage of this method is that at a high temperature the sulphate of ammonia decomposes, and the spectrum of ammonia, which renders the others obscure, is obtained. With some compounds the addition of this salt is unnecessary, as in the cases of the chlorides of silver and mercury.

The use of sulphate of ammonia, indeed, renders it difficult to recognise the haloids when mixed with each other in very small proportions, and it is better to precipitate the haloids first by a silver salt, mix the dried precipitate intimately mixed with twice its weight of oxide of copper, and employ this mixture in the hydrogen apparatus before described. By this method as little as $\frac{1}{10}$th per cent. of chlorine, $\frac{1}{9}$th per cent. of bromine, and $\frac{1}{8}$th per cent. of iodine in the silver precipitate can be recognised.

The spectra of the haloid salts appear consecutively, that of the chloride first, then that of the bromide, and lastly that of the iodide of copper. Their appearance in this order depends on the different volatility of these salts. Chloride of copper volatilises considerably below a red heat, the bromide somewhere near redness, and the iodide at a low red heat. The slower the volatilisation is conducted, the more certain are the results of the analysis.

When only traces of iodine and bromine compounds are present in a large excess of a chlorine compound, about the tenth of a gramme of nitrate of silver should be added to the solution. The greater part of the iodine and bromine will be found in the precipitate, which may be tested as before described.

The following results will serve as an illustration of the accuracy and precision of the process. To a pound of common salt which contained no bromine five milligrammes of bromide of sodium were added, and to the solution one decigramme of nitrate of silver. The precipitate was tested in the way just described, and after the spectrum of chloride of copper had been observed for some time, the spectrum of bromide of copper was distinctly visible for five minutes. A further addition of nitrate of silver to the solution gave a precipitate which showed the spectrum for six minutes.

Similar experiments made with iodine compounds gave equally conclusive results, and proved that a ten-millionth part of iodine or bromine may be detected in chloride of sodium.

The residue of six and a-half pounds of sea water taken off Heligoland [precipitated with silver ?] showed the spectrum of the bromide for seven minutes. Iodine could not be recognised, probably because the quantity of water was too small.

A small quantity of water from the Dead Sea showed a large proportion of bromine, but no iodine. The mother liquor from some salt works showed much bromine, but no iodine.

Where organic matters are to be examined for the haloids a tube with two bulbs must be connected with the hydrogen apparatus. The bulb nearest the flame is filled with oxide of copper only, and the organic matter is placed in the other. Both being heated, the products of the heated organic matter over the oxide of copper reduced by the hydrogen in the second bulb. In this way the smallest amount of chlorine, bromine, or iodine may be recognised; and, indeed, traces of one in a large excess of the other.

The author thought it might be possible to arrive at something like quantitative results by noting the time which the several copper compounds took to volatilise; but he found it impossible to avoid large sources of error.

Researches on the Influence of the Electro-negative Elements on the Spectra of Metals, by M. E. DIACON.‡

THE method of analysis founded by Kirchhoff and Bunsen on spectrum observations have given results so remarkable that its utility in chemical researches is not to be contested. Nevertheless, the principle on which it rests is only true under certain determined conditions. From my own observations and those of A. Mitscherlich it seems certain that the different compounds of a metal do not exhibit an identical spectrum, and in this paper I propose to collect the experiments which show the influence of the electro-negative element on the radiations emitted by different salts of the same metal.

In a series of spectrum researches made on a great number of mineral waters, I remarked some appearances which led me to study attentively the spectrum of barium in the presence of salts of lime or strontia. Under such conditions I not only observed faint lines not indicated for either of these metals, but was further struck by the remarkable change which the spectrum of barium underwent, when a pearl of chloride of calcium was introduced into the same flame.

This phenomenon, consisting in the much greater brilliancy acquired by certain green lines of barium, appeared

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* Abstract from *Poggendorff's Annalen*, No. 8, 1865, p. 629.

† Drawings of the spectrum given by the several haloid salts are given with *Poggendorff's Annalen*, No. 4, 1864.

‡ Abridged from *Annales de Chimie et de Physique*, Sept., 1865.

to me so strange at the time—when it was fully admitted that in the case of a mixture the spectra were simply superposed without influencing each other—that I called in other observers. The observation of a green band, pale and ill-defined, which the spectrum of calcium sometimes presents, and which coincides with the second of the green lines of barium, led me to ascribe it to absorption; the diminished intensity of this line might have produced the sensation of greater brilliancy in the other lines. But all the experiments only gave me negative results; the phenomenon was only produced when the two pearls were in the same flame, and very near to each other. Hence it seemed necessary to admit that the two bodies might act on each other and modify their spectra.

The appearances noticed above not appearing when even volatile compounds of calcium were substituted for the chloride, I soon became certain that they did not belong to the metals themselves. There remained then the action which the chloride of calcium or the chlorine disengaged during the rapid oxidation of the metal in the flame might have on the barium. Experiments which I made with quite a different object set the question at rest.

Many metals whose chlorides are volatile give no spectra in a Bunsen's flame. It is reasonable to believe that the rapid decomposition these chlorides undergo in an oxidising flame is the principal cause of this, and that it would be otherwise, with many of them at least, if the temperature sufficed. This I hoped to realise by placing them in a *chlorinising* flame obtained by the combustion of hydrogen in chlorine. The apparatus adopted after some trials is the following:—A box, blackened in the inside, 60 c.c. high, and 15 c.c. wide and deep, receives the blowpipe; two openings in the sides, to be closed at will by glass, serve one for the observations, the other for the introduction of the matters to be experimented upon. An inclined tile of refractory earth forms the roof of the box, and directs the products of combustion into a second box partly superposed, and of about the same dimensions as the first. This second box contains a number of laths placed horizontally, and carrying slaked lime, so as to leave a free passage for the gas. A long wooden exit tube placed below the laths carries the gas not absorbed by the lime into the chimney, a gas lamp above the opening of the tube acting as an aspirator. The rest of the apparatus is composed of a blowpipe and two gasometers placed outside the laboratory, one of glass for chlorine the other for hydrogen. The gases are conducted by lead pipes, and afterwards by caoutchouc tubes to the blowpipe; the chlorine in a small tube placed within a larger, which carries the hydrogen.

The easy reducibility of chloride of platinum allows wires of this metal to be used as supports. The matters experimented upon are placed in the interior of the flame, so that they may be in the presence of an excess of chlorine, and beyond the influence of external air. Lastly, the spectroscope is directed to that part of the flame situated immediately above the wire support. Under these circumstances a great number of metals give spectra of very variable persistence.

Chloride of copper gives a magnificent spectrum; that of chloride of bismuth is also very brilliant. Chloride of lead shows a great number of brilliant lines, the positions of which seem to differ from those of the metal in the gas flame. With tin, and more especially with antimony, it is often impossible to distinguish the lines which characterise them, on account of the diffused light produced by the decomposition of the salts. The same is the case with the chlorides of platinum and silver. Chloride of gold, however, gives a well-defined spectrum formed of a series of beautiful green lines. With chloride of palladium bright blue lines are seen, but only for a very short time.

Chloride of manganese gives a well-defined spectrum, like that of the salts of the metal in the gas flame. Chloride of iron shows a great number of lines bathed by the light due to the incandescence of solid particles carried by the vapours. The chlorides of cobalt and nickel present the same phenomena, but with less intensity, so that, notwithstanding the great number of lines which constitute them, it is easy to distinguish the spectra of the two salts, the red lines being more numerous in nickel, the yellowish-green lines more numerous with cobalt.

Uranium, cerium, chromium, glucinum, aluminium, and magnesium gave only negative results; to obtain the spectra of these metals it is necessary to experiment with anhydrous chlorides.

Experiments made in the way described showed that certain chlorides decomposed less rapidly in a chlorinising flame, and, therefore, gave spectra; but the experiment with chloride of barium led to results of special interest. That salt gave a spectrum quite different from that of the metal; the large number of lines which characterise the latter had disappeared, and were replaced by a small number of very bright lines. I immediately examined the chloride of strontia, and was no less surprised at perceiving neither the blue nor the orange line, seen so brilliantly in the gas flame. The spectrum of chloride of calcium showed differences no less striking and real. With lithium nothing peculiar was seen. The chlorides of sodium and potassium appeared not to give spectra. Chloride of thallium appeared to present no change, even in the intensity of the characteristic green line.

Modifications so profound can only be explained by admitting that each compound has a peculiar spectrum, but the specific nature of metallic spectra has been so clearly laid down in principle by Bunsen and Kirchhoff that it seemed necessary to support by new experiments a fact so contrary to the results obtained by these authors. If chlorides have peculiar spectra, it must also be the case with bromides and iodides. It was hoped that similar experiments to those made with chlorides would demonstrate this; but attempts to obtain a flame with bromine and iodine and hydrogen did not succeed.[§]

The author now fell back on the first experiment mentioned in this paper. The appearances observed when baryta was heated in the presence of a pearl of chloride of calcium he assured himself were due to the superposition of the spectra of oxide and of chloride of barium. The rapid decomposition of the chloride of calcium surrounding the baryta with an atmosphere of chlorine chlorinised a part, and, consequently, determined the appearance of lines characteristic of chloride of barium. A pearl of chloride of barium by itself presented the same appearances, but with less intensity at the moment it was introduced into the gas flame.

A comparative study of the spectra given by chlorides in chlorine, and by oxides in a blow-pipe flame fed with air or even pure oxygen, soon demonstrated that the lines

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[§] At this stage of his investigation the author met with the memoir of M. Mitscherlich (see CHEMICAL NEWS, vol. vii., p. 99) and repeated that gentleman's experiment, but came to the conclusion that the spectra obtained by his method were simply those of the metal, and that the lines specially belonging to the chlorides escaped observation.

which appear at the moment a chloride is introduced into an oxidising flame are due to the superposition of two spectra. The experiment succeeds best with the alkaline earthy metals, and with copper and bismuth. With the two latter and with calcium the spectrum of the chloride predominates.

Two consequences result from these experiments—1. The spectra given by Kirchhoff and Bunsen for those of the alkaline earthy metals being the appearances observed at the moment the salt is introduced into the flame, it follows that such spectra must be a mixture of the spectrum of the chlorides and of that of the metal; and secondly, the appearance of lines not belonging to the metal may be considered as a probable, if not a certain, indication of the existence of a spectrum peculiar to the compound with which it is produced. Thus the study of the lines produced by bromides, iodides, and fluorides in the gas flame may give valuable indications, and furnish new proofs of the existence of a special spectrum for binary compounds. All the metals do not lend themselves with equal facility to these experiments. The best defined results are obtained with the alkaline earthy metals, and with copper and bismuth.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

SOCIETY OF ARTS.

CANTOR LECTURES.

"*On some of the most important Chemical Discoveries made within the last Two Years.*"

By Dr. F. Crace Calvert, F.R.S., F.C.S.

Lecture 2.

Tuesday, April 11, 1865.

On the Discoveries in Chemistry applied to Arts and Manufactures (Continued).—One of the most curious and important applications which have lately been made of chemistry to manufactures is that of coal gas as a means of obtaining intense heats. In fact, heats have been secured which far exceed those previously obtained by the combustion of coals and other carbonaceous matters.

To understand how this result has been effected, it is necessary that I should say a few words on the combustion of coal-gas. When coal-gas is ignited, the oxygen of the atmosphere first combines with the hydrogen of the hydro-carbons, either gaseous or sufficiently volatile to assume a gaseous form, so as to produce water. Whilst a part of the carbon of these hydro-carbons combines with the oxygen to produce carbonic acid, the other portions of carbon float in the mass of ignited gaseous matters, and reach a sufficient temperature to radiate light in all directions. It follows, therefore, that the richer the coal-gas is in hydro-carbons, into the composition of which enters a large proportion of carbon, the more brilliant will be the flame.

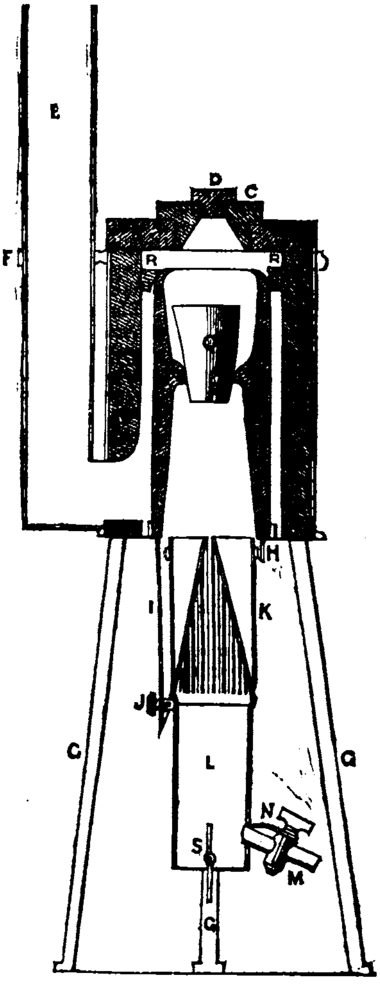
This is beautifully illustrated by an invention which I have the pleasure of showing you through the kindness of the Rev. Mr. Bowditch, of Huddersfield, who has lent me one of the apparatuses which he has lately invented to increase the illuminating power of inferior coal-gas, and which has been applied with success in the city of London by its learned officer of health, Dr. Letheby. It consists in the introduction of carburetted hydrogens, rich in carbon, into the flame of ordinary coal-gas, thus enhancing in a marked degree its illuminating power. This apparatus consists of a gas-tight metallic vessel, which holds the hydrocarbons, and which has an inlet connected with a gas supply and an outlet connected with the burner. The gas in its course passes over the surface of the hydrocarbons. Being above the flame, the vessel and its contents become heated, and part of the latter is converted into vapour, which the passing gas carries with it to the burners to enrich the flame.

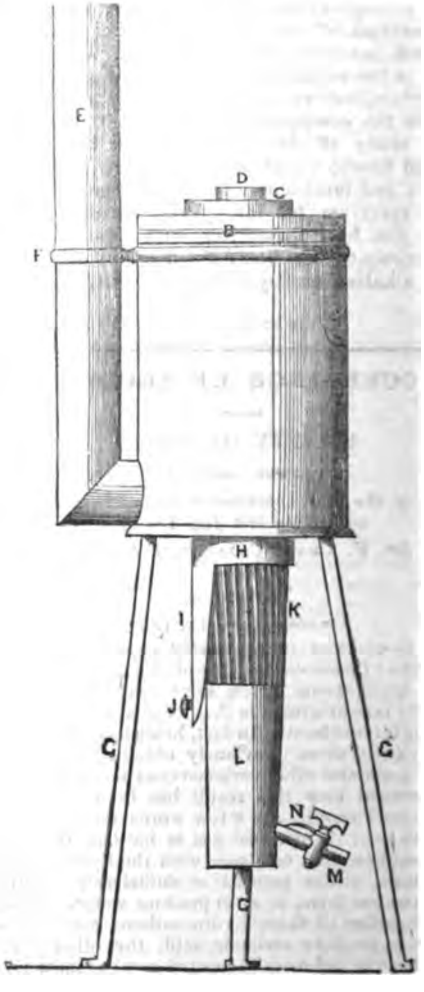
The following are the advantages which Mr. Bowditch's apparatus presents:—Common coal-gas, Ashburton flat flame, fish-tail, and batwing, does not yield a light of 1·5 standard sperm candles per foot, though it yields the light of 2·4 candles per foot when burnt in a 15-hole argand with a 7-in. chimney. By adding 31·5 grains of naphthalin vapour to each foot of this gas, the light-giving value is raised to between seven and eight candles per foot, according to the constitution of the gas with which the vapour is burnt. Oils do not yield quite so high a result as naphthalin; but they afford from 4·5 to 5 times the light given by gas alone. To show the economy of gas, I may cite the following results, given to me by Mr. Bowditch:—A gallon of oil, sold retail for 2s., is capable of producing, with 1000 ft. of London gas, more light than is given by 4000 ft. of gas, or 4s. 6d. gas and 2s. oil against 18s. gas alone. The hydrocarbon vessel requires charging about once in fourteen to sixteen days.

But let us now return to the production of intense heat by the combustion of coal gas. This is effected by burning gas with an excess of air, generally speaking, under pressure, so as to bring into contact in a given space of time a large quantity of gases, especially an excess of oxygen, with a view of rendering perfect combustion of coal-gas. The first instance, to my knowledge, of the perfect combustion of coal-gas as a commercial application was its use in machines for singeing cotton and woollen fabrics, or for the purpose of removing from their surface all loose and useless fibres. One of the most perfect machines which I have yet examined for accomplishing this purpose has been lately introduced to the notice of manufacturers by Joshua Schofield and Sons, of Manchester. The great merit of their machine consists in the fact that by it they can vary either the intensity of the flame or its length, according to the pressure at which the gases in combustion are made to issue from the machine. In fact, they can adapt with such nicety the action of the machine to the nature of the fabrics they have to singe that it can be applied to the finest fabric, such as cambrics, and to some of the heaviest materials in cotton, such as fustian.

The most remarkable example of the intense heat which can be obtained by the combustion of gases was brought into notice a few years since by that distinguished chemist, H. M. St. Claire-Deville (the discoverer of aluminium), by which he succeeded not only in melting several metals which, until his experiments, had resisted all other modes of effecting their fusion, but in melting in his laboratory as much as 25 lbs. of platinum, one of the most refractory metals known, and running it into one solid ingot. In 1862, the well-known metallurgists, Messrs. Johnson and Matthey, invited to their works a large circle of the most scientific men of Europe, who were attending the Exhibition as jurors, to witness the fusion of 220 lbs. of platinum, and the running of it into one single solid ingot. This wonderful exploit in the production of heat was effected in a furnace similar in principle to that which had been devised by M. St. Clair-Deville, viz., in a furnace, the inner part of which was lined with blocks of quick lime, the only material found by M. Deville to be susceptible of resisting the intense heat which was produced by bringing at the upper part of the furnace a large jet of gas and air intimately mixed, and working under pressure. The flame, in passing from the upper part of the furnace and making its exit at the lower part, produced so great a heat as to melt the above-stated quantity of platinum.

The observations of M. Deville soon brought into existence some extremely simple and handy furnaces to effect fusions and assays on a laboratory scale. Some of the best furnaces contrived for that purpose are due to Mr. J. J. Griffin, of Bunhill Row. The principal feature of his furnace is using as a generator for heat a large Bunsen burner, which consists of a hollow tube, at the bottom of which there is an inlet for coal-gas, and at a certain height in the tube a number of openings through which the air rushes in to mingle with the gas; both air and gas issue at the top of the tube, and when ignited produce an intense heat. The flame so produced is made to play round a crucible containing the materials to be assayed, and which itself is surrounded by thick earthenware tiles, preventing the heat passing through the furnace from radiating itself in all directions, thus concentrating its action entirely on the little crucible placed in the centre. But the most perfect contrivance of the sort which has yet been brought to the notice of the public is one due to Mr. G. Gore, F.R.S. The following is the description of Mr. Gore's gas-furnace:—A is a cylinder of fire-clay, about nine inches high and six inches diameter, open at both ends, and with a hole at the back part near the bottom, to lead into the chimney; it is covered by a moveable plate of fire-clay, B, with a hole in its centre for the introduction of the crucible or of substances to be melted; this hole is closed by a perforated plug of fire-clay, C, for access to the contents of the crucible; and that again is closed by another stopper of fire-clay, D. E is a chimney of sheet iron, about five or six feet high, kept upright by a ring of iron, F, attached to the top of the furnace. The fire-clay cylinder is enclosed in a sheet iron casing with a bottom of iron, to which are fixed three iron legs, G. An iron tube, H, with a prolongation, I, supports by means of the screw, J, the burner, K, and its tube, L, which is open at both ends. Gas is supplied to the burner by means of the tap, M, which has a small index, N, attached to it for assistance in adjusting the gas. Inside the largest cylinder is another fire-clay cylinder or cupola, O, with open ends, and with three projections of fire-clay, P, for supporting the crucible, Q; it is kept steady by means of three clay wedges; R S is an air-valve for closing the bottom of the tube L. The gas-burner is a thin metal cylinder, deeply corrugated at its upper end, with the corrugations diminishing to nothing at its lower end, as shown in the engravings. The action of this furnace is as follows:—Gas is admitted to the open tube L by the tap M; it there mixes with air to form a nearly combustible mixture, which ascends through the burner, and burns in the clay cylinder O, being supplied with the remainder of air necessary to combustion through the tube H to the outer surface of the flame by means of the spaces between the corrugations. The flame and products of combustion pass up through cylinder O, and then downwards outside of it to the chimney, the point of greatest heat being at Q.





Mr. Gore states that one of his smallest furnaces, consuming 33 feet of coal-gas per hour, is capable of melting 8 oz. of copper and 6 oz. of cast iron; that the next sized furnace, consuming about twice the quantity of gas, will melt 40 oz. of copper.

But the most important improvement which has been effected of late years in the production of intense heat by the combustion of the gases generated through the distillation of inferior coals is that of Mr. C. W. Siemens, F.R.S., of Great George Street. The benefits which are conferred on manufacturers and the public by the furnaces devised by Mr. Siemens cannot be overrated. They are not only economical in their use, but, as they enable the manufacturer to use an inferior class of fuel to generate the heat required, they must undeniably be of great advantage; and to the public in general they will be a great boon, as they do away with the nuisance attached to all manufacturing districts in the dark black smoke escaping from chimneys, polluting the atmosphere, and rendering it so disagreeable to those who are compelled by their occupations to live within reach of its influence.

I may state, *en passant*, that the large amount of black smoke which floats in the atmosphere of Manchester, Sheffield, Birmingham, and other towns, is not only injurious by depriving those places of much light,—so beneficial to life and health—but is also a nuisance from the immense amount of soot and dirt with which it is accompanied. There cannot be a doubt that, owing to the imperfect combustion which the products undergo in many of the furnaces belonging to manufacturers, and which is shown by the appearance of the smoke itself, the air is rendered more unwholesome than it would be if the products that escape had undergone perfect combustion, because volatile matters escape which are known to have a most destructive action on health and vegetation. The improved state of the public squares in London, and especially of those which are on the banks of the Thames, can be witnessed by all who have observed their condition since the consumption of smoke has been made compulsory in London and its suburbs.

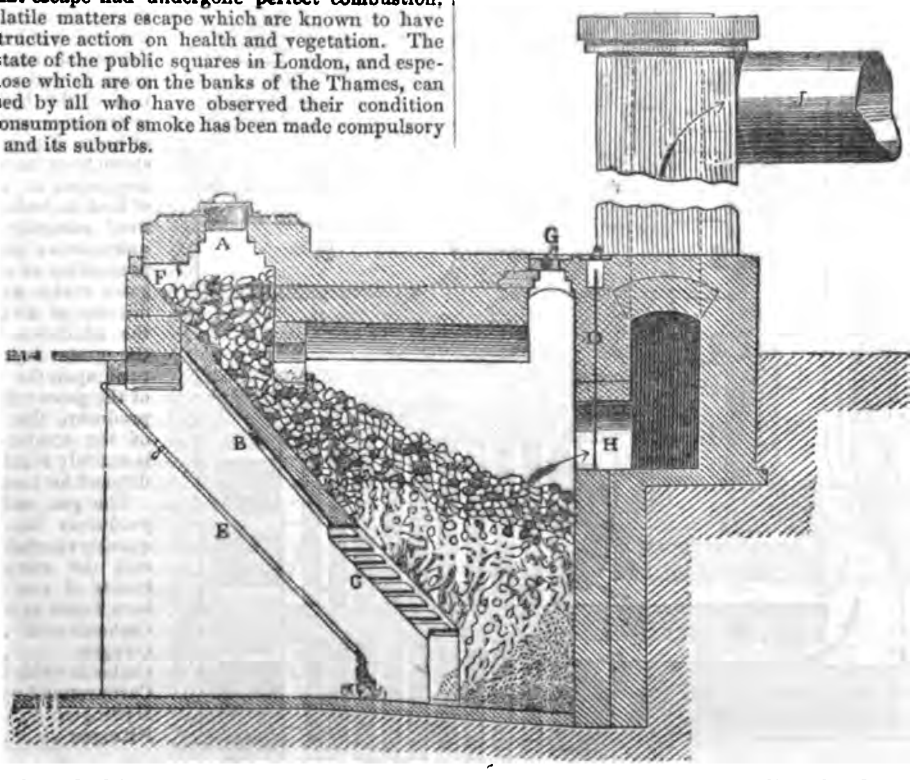
Mr. Siemen's furnaces, I am happy to say, are not in a state of mere experiment, but they have received the sanction of a great number of manufacturers, and especially of those who little expected that the necessary heat for their operations could be obtained without interfering with their manufacture, in the carrying out of which they thought the production of smoke could not be prevented. Thus, we find M. Siemen's furnaces employed with great success and economy in glass works, in potteries, and in iron forges,—works which used to be a nuisance to their neighbours, by the large volumes of black smoke which they were constantly emitting from their chimneys.

Before describing Mr. Siemen's furnace, it is necessary that I should state that, in the ordinary furnaces, only about 25 per cent. of the heating power of the fuel is rendered available in carrying out the manufacturing operations. This is due to imperfect combustion, and to the fact that only the heat of combustion exceeding that of the body treated is utilised; the remainder of the heat, in many instances, by far the greater proportion of the whole, being allowed to escape uselessly up the chimney.

I shall now give a description of one of M. Siemen's furnaces. The gas-producer and furnace are quite distinct, and may be placed at any convenient distance from each other. The gas-producer is shown in Fig. 1. The fuel is supplied, at intervals of about two hours, through the covered openings A, and descends gradually on the inclined plane B, which is set at an inclination to suit the kind of fuel used. The upper portion of the incline B is made solid, being formed of iron plates covered with fire-brick, but the lower portion C is an open grate formed of horizontal flat steps. The opening under the lower step is made larger than the others, to enable clinkers to be withdrawn. The small stoppered holes F F at the front, and G G at the top, of the producer are provided to allow of putting in an iron bar occasionally to break up the mass of fuel, and detach clinkers from the side walls. Each producer is capable of converting daily about two tons of fuel into a combustible gas, which passes off through the opening H into the main gas flue leading to the furnaces.

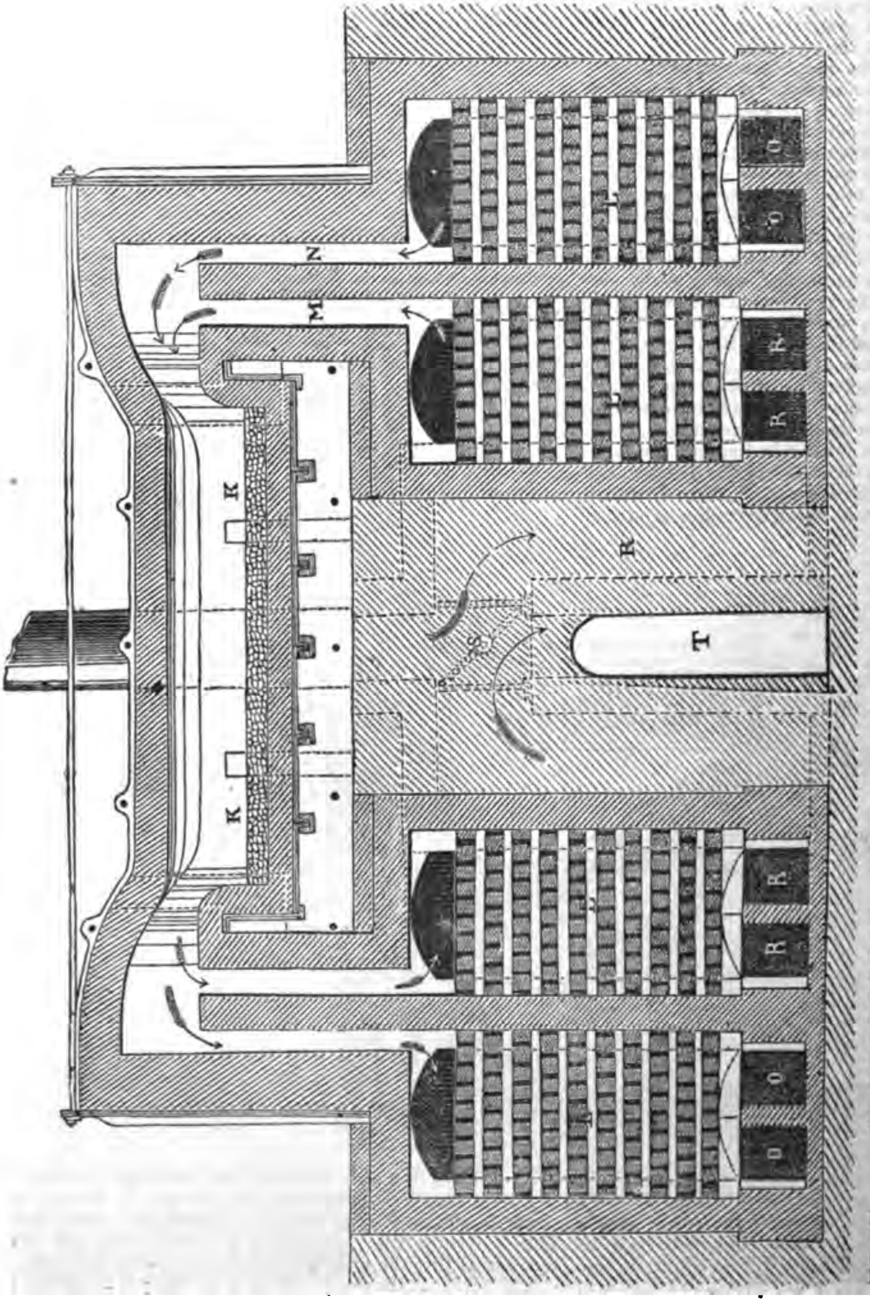
The action of the gas-producer in working is as follows:

Fig. 1.



—The fuel, descending slowly on the incline plane B, becomes heated, and parts with its volatile constituents,—the hydrocarbon gases, water, ammonia, and a small proportion of carbonic acid—which are the same as would be evolved from it in a gas retort. There now remains from 60 to 70 per cent. of purely carbonaceous matter to be disposed of, which is accomplished by the current of air slowly entering through the grate C, producing regular combustion immediately upon the grate; but the carbonic acid (an incombustible gas) thus produced having to pass slowly through a layer of incandescent fuel from two to three feet thick, takes up another equivalent of carbon, and is thus transformed into carbonic oxide (an inflammable gas), which passes off with the other combustible gases to the furnaces. For every cubic foot of carbonic oxide thus produced, taking the atmosphere to consist of one-fifth part by volume of oxygen, and four-fifths of nitrogen, two cubic feet of incombustible nitrogen pass also through the grate, tending greatly to diminish the richness or heating power of the gas. Not all the carbonaceous portion of the fuel is, however, volatilised on such disadvantageous terms; for water is brought to the foot of the grate by the pipe E, which, absorbing the spare heat from the fire, is converted into steam, and each cubic foot of steam, in traversing the layer of from two to three feet of incandescent fuel, is decomposed into a mixture consisting of one cubic foot of hydrogen, and nearly an equal volume of carbonic oxide, with a variable small proportion of carbonic acid. Thus, one cubic foot of steam yields as much inflammable gas as five cubic feet of atmospheric air; but the one operation is dependent upon the other, inasmuch as the passage of air through the fire is attended with the generation of heat, whereas the production of the water gases, as well as the evolution of the hydrocarbons, is carried on at the expense of heat. The generation of steam from the water, being dependent on the amount of heat in the fire, regulates itself naturally to the requirements; and the total production of combustible gases varies with the admission of air; and since the admission of air into the grate depends in its turn upon the withdrawal of the gases evolved in the producer, the production of the combustible gases is entirely regulated by the demand for them.

Fig. 2.



The gas made in these producers has been frequently carefully analysed, and the average constituents of 100 parts have been found as follows:—

Carbonic acid	4·1
Oxygen	0·4
Carbonic oxide	23·7
Carburetted hydrogen	2·2
Hydrogen	8·0
Nitrogen	61·5
	99·9

The furnaces are applicable for all purposes where intense heat is required,—such as for glass-houses, puddling, heating iron and steel, iron melting for foundry purposes, steel melting, muffles and copper smelting. In all applications the furnaces are of the same construction in principle, the arrangements only varying with the different operations to be carried on in the heating chamber. The heating furnace has been selected for illustration in Fig. 2.

Underneath the heating chamber K are placed transversely the four regenerators L L L L, which are chambers filled with fire-bricks built up with spaces between them. The regenerators work in pairs, the two under the right-hand end of the furnace communicating with that end of the heating chamber, while the other two communicate with the opposite end.

The gas passes from the main gas flue through the reversing valve S into the flues R R, at the bottom of one of the regenerators L, up through which it passes to the port M. Air is also admitted through a reversing valve at the back of S (not shown in the figure), thence into the flues O O, up through the second regenerator L, to the port N, where it meets with the gas, mingles with it, and produces an intense and uniform flame, which distributes itself all over the heating chamber K.

The products of combustion together with the excess or waste heat of the furnace, instead of being passed, as in ordinary furnaces, up the stack, and either entirely thrown away or only partly utilised, are carried down into the other pair of regenerators, where they are deprived of their heat, and thence proceed through the reversing valves to the chimney by the flue T.

When one pair of regenerators has become considerably heated by the passage of the hot products of combustion for some time, and the opposite pair correspondingly cooled by the upward passage of the cold gas and air, the valves are reversed, and the currents of gas and air then pass upwards through the regenerators last heated, whereas the products of combustion pass through those opposite. The process of reversing is repeated at fixed intervals, generally every half hour, so that two of the regenerators are always being cooled by the gas and air taking up the deposited heat and carrying it back to the furnace, and two always being heated by the passage of the hot products of combustion passing down to the chimney, and depositing their heat on their way there.

The flame in the heating chamber is uniform throughout, and perfectly free from all extraneous matter. Its chemical nature is also perfectly under command by means of gas and air regulating valves (not shown in the engravings), so that the most delicate operations can be carried on with great uniformity.

The gas and air reach the heating chamber (after passing through the regenerators) at nearly the heat of that chamber itself, and in burning, in addition to the temperature due to their mutual chemical action, is added that they have taken up in passing through the regenerators, so that an intensity of heat is obtained, which, unless moderated on purpose, would fuze furnace and all exposed to its action.

The products of combustion are so completely deprived of the heat they brought out of the heating chamber K, by passing among the regenerator bricks, that the heat in the chimney-flue is seldom sufficient to singe wood; the economy is therefore due to the fact that little or no heat is thrown away up the chimney, as in the ordinary furnaces, and also to the perfect combustion of the fuel, which is evidenced by the total absence of smoke from the stack; whereas in the common furnaces the combustion is so imperfect that clouds of powdered carbon, in the form of smoke, envelope all manufacturing towns, and gases are allowed to escape with two-thirds of their heating power undeveloped.

The saving of fuel in these furnaces, as compared to the ordinary kind, ranges between 40 and 60 per cent. in weight, according to the fuel used. In many instances an additional saving can be made in the cost of the fuel by using inferior qualities, such as coal and coke dust, lignite, and peat.

The intensity of the heat, purity of the flame, and the absence of cutting draughts in the heating chamber, is of great advantage for all metallurgical operations, tending greatly to improve the quality of the produce, and occasioning a saving of about 5 per cent. in the waste of the metal treated in puddling and iron re-heating furnaces, &c.

The peculiarities and advantages of these furnaces are, that gas fuel alone is employed, that perfect and entire combustion is obtained, and that the heat, which is usually allowed to escape up the chimney, is here stored up to be afterwards brought back to the furnaces.

(To be continued.)]

CHEMICAL SOCIETY.

Thursday, November 16.

Professor W. A. Miller, *M.D., F.R.S., President, in the Chair.*

Before proceeding to the ordinary business of the evening, the President, pursuant to notice, reminded the Society that it had been proposed to entertain suggestions having reference to the disposal of some chemical specimens and products which had from time to time been presented to the Society, but were even now far from being a complete collection. Their number amounted to more than could be conveniently accommodated in the glass cases of the adjoining library, and their importance did not warrant an expenditure for their proper display; but, inasmuch as the Council did not feel themselves justified in disposing of them without the sanction of the Fellows being first obtained, he was instructed by his colleagues in the Council to say that they would be prepared to act upon any suggestion which met the wishes of the meeting. Dr. Miller concluded by reading an extract from the Royal Charter to the following effect:—"And we further will, grant, and declare, that the whole property of the said body politic and corporate shall be vested, and we do hereby vest the same solely and absolutely in the Fellows thereof, and that they shall have full power and authority to sell, alienate, charge, and otherwise dispose of the same as they shall think proper; but that no sale, mortgage, incumbrance, or other disposition of any messuages, lands, tenements, or hereditaments belonging to the said body politic and corporate shall be made except with the approbation and concurrence of a general meeting."

It was then proposed by Dr. Gladstone, and seconded by Mr. Makins, "that authority be given to the Council to dispose of the chemical specimens in any manner which may seem to them fit."

Professor Church protested against the dispersion of the Society's Museum, which, although now but small, might become the nucleus of a larger and more important collection. He considered that the donation of specimens should be encouraged, for he had himself derived benefit from their inspection, and had on more than one occasion been favoured with a loan for purposes of comparison. To return them again to the donors was unsatisfactory, and to distribute them in any other way was a breach of good faith.

Mr. J. Newlands spoke in favour of the desirability of forming a museum of chemical specimens.

The President reminded the Society of the limited nature of the accommodation at Burlington House, and put to the vote the original motion, which was carried by a large majority.

The minutes of the last ordinary meeting were then read, and the donations to the Society's library announced; after which the members proceeded to ballot for the election of Mr. William Marriott, of Huddersfield, and Mr.

Charles Umney, 40, Aldersgate Street, London, both of whom were duly elected as Fellows. The names of the following candidates were read for the first time:—viz., John Percy, M.D., F.R.S., Lecturer on Metallurgy, Royal School of Mines; Ernest T. Chapman, George Street, Portman Square; Charles N. Ellis, Bow Common; and Thomas Ward, Bolton. For the second time were read the names of John Hunter, M.A., Queen's College, Belfast; Theodore Maxwell; William Jacob Barnes, Starling Lodge, Buckhurst Hill, Essex; W. E. Bickerdike, Dalton Square, Lancaster; Richard Fitz' Hugh, Nottingham; Dr. William B. Ritchie, Belfast; and Alfred G. Brown, M.R.C.S., Trinity Square, Southwark.

A paper "*On Nitro-Compounds (Part II.), with Remarks on Isomerism,*" by Edmund J. Mills, D.Sc., was read by the Secretary. The author's experiments were mainly directed to the chemical examination of the *alpha* and *beta* varieties of nitrobenzoic acid, and to the remarkable differences observed in the action of hydriodic acid upon them, which are considered as indicating a difference between the nitryl radicals they contain. Reference was made to a former paper in which this view was first advanced, and the author believes he has established the following facts and inferences—viz., that benzoic acid prepared from gum benzoin is nitrated only with difficulty, whereas that obtained from β-nitrobenzoic acid is nitrated with remarkable ease. A mononitro-compound is obtained as the usual product of the first reaction, whilst in the latter case a dinitro-compound is formed. By raising now the energy of the mode of attack (by employing a mixture of concentrated nitric and sulphuric acids), the author has succeeded in procuring the dinitrobenzoic acid at once from the ordinary variety of benzoic acid, and the fusing points and other physical characters are found to be nearly identical with those presented by the product of the action of nitric acid alone upon toluol, and described under different names by Fischer, by Wilbrand and Beilstein, and much earlier, by Abel. Dr. Mills thus recognises two species of benzoic acid, which may, perhaps, bear a fundamental relation to the two potassic benzoates discovered by Gregory. The concluding part of the paper is devoted to a critical examination of the nature of isomerism, and the author controverts the ordinary view which supposes that all bodies are constituted of atoms fixed in space, and that isomeric substances are produced by a variation of the *position* of some radical or radicals in the same molecule. On the other hand, the author advocates the principle of atomic motion—so largely accepted in physics, so little in chemistry—and believes that the energy of the chemical reaction at the moment of transfer of the nitryl-radical may confer upon it specific functions, and may account for the differences observed in the isomers—in fact, that it is altogether a question of *force*.

Dr. Odling remarked that the paper before them was one which deserved a careful study, and he regretted, from its having so recently come in possession, that he could not follow the author, on first reading, so closely as he should have wished. He understood that Dr. Mills contradicted the results of Fittig and others, and argued the existence of special functions on the part of the nitryl, denying the necessity of replacing any particular atom of hydrogen in a compound molecule by NO_2.

Dr. Hugo Muller said that, so far as he could follow the subject of the interesting paper just now read, it appeared to him that Dr. Mills had somewhat changed his views regarding the nature of the nitro-compounds, and seemed now more inclined to ascribe the difference of deportments of the nitryl (NO_2) in various nitro-compounds, when they are submitted to the action of reducing agents, rather to the peculiar nature of the "rest" than to the polymeric nature of the nitryl which he sought to establish in his former paper. With regard to the formation of nitrodracylic acid from toluol, the speaker said that the quantities of nitro- and dinitro-toluol formed along with it depended in all probability on the mode of conducting the operation. State of concentration and time of action of the acid must influence the result. Toluol when acted upon by dilute nitric acid is gradually, but entirely, converted into benzoic acid, nitrodracylic acid, and a very soluble and readily fusible acid, which may be identical with the one just described by Dr. Mills, as having been formed by the action of nitric acid upon the benzoic acid obtained from amidodracylic acid.

Dr. Odling then referred again to some passages in Dr. Mills' paper, from which it appeared that he still entertains the views expressed on a former occasion with regard to the nature of the nitro-compounds.

Dr. Muller then said it required a closer study of the author's paper to enable one to enter upon a discussion of it, but he still thought that the assumption of the nitryl occupying different places in the ordinary nitrobenzoic acid and the nitrodracylic acid, would suffice to account for the differences exhibited by these bodies. Some years ago, when engaged, conjointly with Dr. De la Rue, in the investigation of the products of the action of dilute nitric acid on the homologues of benzol, he had prepared a large quantity of benzoic acid from toluol, which, although subjected to various treatments for the purpose of purification, yet showed a certain peculiar difference from ordinary benzoic acid, and this gave rise to the opinion that the acid in question was identical with Kolbe and Lautemann's salylic acid. Fittig, however, proved afterwards the identity of this acid with benzoic acid. A minute admixture of some other substance was the cause of this difference, and on repeating Fittig's experiments benzoic acid was obtained, which in every respect was identical with the ordinary benzoic acid. As in all probability the acid obtained by the action of dilute nitric acid upon toluol is identical with that obtained from amidodracylic acid, and inasmuch as this latter, according to Dr. Mills's experiments, shows a certain difference from ordinary benzoic acid in its deportment with concentrated nitric acid, the acid obtained from toluol might, after all, turn out to be not identical, but isomeric, with benzoic acid.

Professor G. C. Foster said he was well acquainted with the views held by his friend and former colleague, Dr. Mills, and that he conceived the existence of two kinds of nitryl, one of which could be reduced to nitric oxide, and the other to amide by the same mode of treatment. The speaker did not, however, give his assent to Dr. Mills's views.

The President moved a vote of thanks to the author for his interesting communication, and then declared the meeting adjourned until Thursday, December 7, when Dr. J. H. Gladstone would read a paper "*On Pyrophosphotriamic Acid.*"

PHARMACEUTICAL SOCIETY.

Wednesday, November 1.

Mr. Hills, *Vice-President, in the Chair.*

Mr. Hanbury read a paper by Mr. L. W. Stewart, of the Madras Army, "*On the Medicinal Uses of the Indian Species of Barberry.*" It was stated that a strong tincture of the bark in combination with liquor arsenialis had been found useful in cases of intermittent, remittent, and typhus fevers. The author conjectured that a tincture of the kind was one of the ingredients of Warburg's fever tincture.

From a conversation which followed the reading of the paper, we gathered that the composition of Warburg's fever tincture was still a secret, and its value doubtful. It was formerly furnished to Indian troops by the Government, but its use had been discontinued, and now little was sold in India.

Professor Redwood read a short communication by Mr. Barber "*On Red Oxide of Mercury Ointment.*" The author recommended the use of yellow in place of white wax. The formula recommended was as follows:—Red oxide of mercury, 1 part; yellow wax, 2 parts; almond oil, 6 parts. An ointment made in this way kept its colour, and did not become rancid. The Professor afterwards mentioned some cases in which colouring matter seemed of some importance. One was that of ceratum saponis, which made with brown vinegar was a much more satisfactory preparation than when made with acetic acid.

Mr. **Hanbury** spoke of the importance of the use of *pure* white wax in pharmacy, and more particularly in the preparation of cold cream.

The **Chairman** mentioned that pure white wax is always sold in square blocks; that in round cakes is always adulterated. He added that the keeping of ointments sweet was a matter of great difficulty; but a most important point was never to fill a pot without having it well cleaned and scalded out.

Dr. **Attfield** mentioned a gross case of quack imposture. He had had forwarded to him a white powder imported from France, and sold here as *solid cod liver oil.* On examination, it proved to be nothing more than sugar of milk, barely flavoured with cod liver oil.

[Can any one tell us what cod liver oil pills are made of? We have seen in a window in Fleet Street a large bottle of brown cod liver oil, having a comparatively small hollow stopper filled with pills; a label attached states that the pills in the small stopper have the medicinal value of the oil in the big bottle.—Ed. C. N.]

In the course of a conversation introduced by a reference to the Excise interference with the sale of quinine wine, Professor **Redwood** took the opportunity of stating his view of the law as it relates to the retailing of drugs. It was derived from a leading article in the *Pharmaceutical Journal* for August, 1843, embodying extracts from a pamphlet published in 1830 on the Stamp Acts passed in the years 1802 and 1812, which if they have never been repealed, have never been enforced, nor held authoritatively to be open to the construction sought to be put upon them. The Professor's opinion is most concisely expressed in the concluding sentence of the article mentioned. "It would appear . . . that grocers, oilmen, hucksters, and other unqualified persons, cannot legally sell medicines, either simple or compounded, without taking out a license, and cannot sell compounded medicines, such as tinctures, pills, &c., without attaching a stamp to each article."

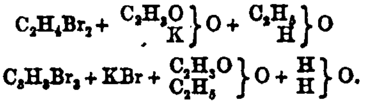
ACADEMY OF SCIENCES.

November 13, 1865.

We may notice the last paper in the *Comptes Rendus* first, as being the most important. It is a note, by M. Campisi, announcing the formation of "*A Compound of Mercury and Benzyle* $Hg(C_7H_7)_2$." The method by which he has prepared it is not yet given. The compound is found to crystallise in white needles, which fuse at a temperature above 200° C. It is slightly soluble in cold alcohol, more so in boiling alcohol, and more soluble still in ether. By means of this compound the author hopes to obtain other metallic compounds with benzyle.

The next paper in importance is a note by M. Baudrimont, "*Researches on the Nature of White Phosphorus,*" in which he establishes that white phosphorus is neither a hydrate nor an allotropic state of ordinary phosphorus, and that it does not result from a sort of devitrification of transparent phosphorus; but that it is, in fact, merely ordinary phosphorus irregularly corroded on the surface by the action of air dissolved in the water, a slow combustion which is accelerated by the action of light, and which ceases as soon as the water holds no more oxygen in solution. We give some of the experiments which appear to decide the matter. Phosphorus covered with a white crust lost next to nothing in drying, while a stick of transparent phosphorus exposed in distilled water lost weight as it became covered with the crust. If the crust had been a hydrate, an increase of weight would have been observed. On becoming covered with the crust phosphorus loses none of its properties; its solubility and fusion point remain exactly the same, and it is as readily transformed into red phosphorus. Hence it would appear that nothing like an allotropic difference is observable. Lastly, it is shown that water deprived of air and oxygen has no effect on semi-transparent phosphorus, while other specimens kept in water containing air, and often renewed, become covered with the white crust, the water becoming acid from the formation of phosphorous acid.

M. Oppenheim presented a "*Contribution to the History of Allylene.*" In continuation of his researches, the author has studied the action of oxygenated salts on the compounds of allylene, with iodine, bromine, and hydriodic acid. He prepares iodide of allylene in quantity by exposing allylene in contact with a solution of iodine in iodide of potassium to sunlight, in sealed flasks, for a couple of months. The iodide formed is an oily body, which distils from 196° to 200°. Salts of silver, acetate and oxalate for example, act on the iodide with difficulty; but when heated in sealed tubes with these salts and with ether or glacial acetic acid, the iodide of allylene is almost completely carbonised. An alcoholic solution of acetate of potash acts on the iodide, setting allylene free, while the acetic acid and alcohol form acetate of ethyl. To form acetic acid hydrogen is necessary, and therefore a part of the iodide of allylene should be reduced to $C_3H_2I_2$ or C_2HI; but the author has not yet been able to prove the presence of such bodies. Bibromide of allylene behaves with regard to the salts of silver like the iodide. The reaction of tetrabromide of allylene with alcoholic acetate of potash is very definite, and is represented by the following equation:—



$$C_2H_4Br_2 + \left.\begin{matrix} C_2H_3O \\ K \end{matrix}\right\} O + \left.\begin{matrix} C_2H_5 \\ H \end{matrix}\right\} O$$

$$= C_3H_3Br_3 + KBr + \left.\begin{matrix} C_2H_3O \\ C_2H_5 \end{matrix}\right\} O + \left.\begin{matrix} H \\ H \end{matrix}\right\} O.$$

In this reaction it is seen that the tetrabromide of allylene does not behave as the bromide of a hydrocarbide, but more like the hydrobromate of a bromated hydrocarbide —the hydrobromate of bromated propylene, for example, $C_3H_3Br_3HBr$.

Thus the bromine of the bromides of allylene seems to be united with the carbon as strongly as the hydrogen; the bromine, so to speak, has entered into the radical, and then the bromides of allylene behave like substitution products, which do not exchange their bromine for the residue HO.

The product of the above reaction, $C_3H_3Br_3$, *tribromated propylene*, is an unstable, colourless body, boiling at 183° -- 185°, and is distinguished by this characteristic from the isomeric compound formed by Liebermann by the action of bromine on allylenide of silver (C_3H_3Ag). This latter body, which may be regarded as bibromide of monobromated allylene, is completely destroyed by boiling.

Tribromated propylene exposed to the light with bromine is slowly transformed into a solid pentabromide, or bibromide of tribromated propylene. It crystallises from ether in beautiful prisms. Allylene is combined with hydriodic acid by introducing a concentrated solution of the acid into flasks filled with allylene. Heat is disengaged, and a heavy oil, bihydriodate of allylene, is formed. Alcoholic potash reduces this body to monohydriodate, which has nearly the same boiling-point as its isomer iodide of allyl, from which, however, it is distinguished by its behaviour towards bromine, and also by its odour.

M. C. W. Blomstrand made another communication on the "mysterious" metal *Niobium.* The author has compared his own results with those of Marignac, and expresses a general concurrence with the views of the latter chemist. They agree that hyponiobic, niobous, or dianic acid is only the acid of niobium, corresponding to tantalic acid, and concur in thinking that the mineral Rose experimented with, and prepared the yellow niobic chloride from, must have contained a considerable quantity of tantalum. Marignac regards niobium and tantalum as pentatomic metals; but Blomstrand considers them as a bi- or tetratomic. We shall probably hear a good deal of niobium before the question is decided.

M. Cailleletet presented a note "*On the Gases contained in Cast Iron and Steel in a State of Fusion.*" As the metals run into moulds and solidify, a large quantity of gas escapes. The author has succeeded in collecting this gas and analysing it. We give the percentage composition of the gas from grey cast-iron obtained with coke:—Hydrogen, 33·70; carbonic oxide, 57·90; nitrogen, 8·40. He is in doubt whether the nitrogen really escaped from the metal, or whether it was derived from air in his apparatus. We may give some account of the apparatus used, with cast-iron, at a future time. No apparatus the author could contrive would stand the experiment with cast iron, and all he can say of the gas escaping from it is, that it contained hydrogen and carbonic oxide, but the imperfection of his apparatus always admitted air.

M. Gernez sent a paper "*On Supersaturated Solutions.*" It was a reply to M. Jeannel, who attributes the sudden crystallisation of supersaturated solutions to purely physical causes. M. Gernez, our readers know, asserts that the crystallisation is brought about by the contact of a solid particle, no matter how minute, of the substance held in solution. In his present paper, M. Gernez says, at some length, that he has repeated all M. Jeannel's experiments, and has only arrived at results which confirm his own views.

M. Maumené presented a note "*On the Origin of the Sulphuretted Waters of the Pyrenees.*" The author believes he has discovered a double sulphide of iron and sodium in the slaty schist through which the water rises at Cauterets; and he makes the announcement at this moment in order that all the scientific world may take notice and stand aside while he continues the studies necessary to demonstrate that which at present he only believes to be extremely probable, viz., the existence of a double sulphide of iron and sodium in all rocks from which sulphuretted waters issue.

We cannot understand upon what principle the publication of papers in the *Comptes-Rendus* is regulated. We find, for instance, the following:—M. Zaliwski read note "concerning a law, which, according to him, enables us to recognise *à priori* the solvents of iodine." The note is not published; but whatever it may have been, it could hardly have been more stupid than some that are published every week.

NOTICES OF BOOKS.

Chemistry and its Founders: Ferdinand Hoefer, La Chimie enseignée par la Biographie de ses Fondateurs. Paris: Hachette. 1865.

To instruct, to amuse, and to furnish matter for thought—"instruire, plaire, et donner à penser"—has been Dr. Hoefer's object in writing the charming little volume before us, and among the valuable works of this distinguished author we have here one which will assuredly take a very high place. Since the appearance of Liebig's well-known "Letters on Chemistry" and the late Professor Johnston's "Chemistry of Common Life" there has been no work calculated to inspire so intense a love for chemical research in the student, or to afford so much interest to the professional chemist, as the present volume.

Starting from the commencement of things, Dr. Hoefer treats, in his first section, of the birth of chemistry and its gradual development through the periods of *Alchymy* and *Pneumatic Chemistry* to that of *Modern Chemistry*, dating from the epoch of Robert Boyle, where we get the first glimpses of chemical analysis.

Around the biographical sketches of Boyle, Lavoisier, Priestley, Schéele, and Davy, in the second division of the work, are grouped those of less famed philosophers, and the discoveries of those facts upon which has been built the present colossal and useful structure of modern chemistry. In spite of the disadvantages to which science has ever been submitted in this country, compared with France and Germany, English discoveries hold a very prominent position in Dr. Hoefer's work. Indeed, since the appearance of his "Histoire de la Chimie," in two vols. (for a new edition of which chemists have long been waiting), we may safely state that this is the first time the history of chemical research has been touched upon by a truly impartial and extremely competent judge, and England will, we doubt not, be proud of the work. Schéele and Davy are, upon the whole, the finest flowers in this brilliant chemical bouquet, and the section of the book devoted to them reads with all the interest of romance. The third, and last, portion is devoted to the *future of chemistry*, which our author, acting up to the poet Longfellow's principles, goes forth to meet "without fear and with a manly heart."

To assert that the origin of chemistry is lost in the "nuit des temps" is, according to Dr. Hoefer, a sonorous phrase which teaches nothing. We must seek this origin in the workshops of the blacksmith, the enameller, the colour-maker, and the druggist; nay, even in the kitchens of our ancestors long before the word *chemistry* existed. This word, whose origin and meaning has been cause of much discussion, the author shows to date from the fourth or fifth century, and to signify the *art of melting or dissolving*. The birth of the process of *distillation* is traced back to the time of Pliny. Aristotle, who lived three centuries earlier, knew that liquids were evaporated by heat, and that their steam condensed again by cold, but Pliny gives (in his *Nat. Hist.*, xv. 7) the first vestige of a distilling apparatus. He says, "The fire is lit under the pot which contains the resin; the vapour rises and condenses on the cloth which is spread over the orifice of the pot; when the operation is finished the cloth, impregnated with oil, is squeezed."

In ancient times the art of manipulating and the art of thinking—in other terms, the artisan and the philosopher—were separated by an immense abyss; and before arriving at the state of alchemy, the science of chemistry had to wade through a very curious "sacred" period, to which Dr. Hoefer has devoted some interesting pages. This *sacred* or *divine art* was first practised by the Egyptian priests. The evaporation of water was observed to leave a sediment of earthy matter whilst the vapour rose in the air; hence it was concluded that water was *transformed* into earth and air. From *transformation* to *metempsychosis* there was only a step. Again, lead or tin was calcined; the oxidation which occurs signified the *death* of the metal. The oxide heated in its turn with grains of wheat reproduced the lead; this was the *revivification* or *resurrection* of the metal. "The grains of wheat," says Dr. Hoefer, "were the symbol of resurrection or of immortality, as appear to attest the little satchels of wheat found with the Egyptian mummies." The alchemists knew, amongst other things, that copper dissolves in nitric acid, and that when a piece of iron is thrown into the solution the copper is deposited whilst the iron disappears. Let us place ourselves in the position of the alchemists in presence of this pseudo-curious fact, should we not have said, as they did, that *the iron was transformed into copper?* The famous theory of the *transmutation of metals* reposed, indeed, upon well-observed facts, but facts which were erroneously interpreted. As to the *philosopher's stone*, we are here again shown that the alchemists themselves varied considerably in opinion about it. In order that his readers may judge what sort of a life an alchemist led, our author gives the history of the enthusiastic Denis Zacaire, born in 1510, who, having inherited a small fortune from his parents, was robbed, first by an Arab, then by a Greek, next by a French or a German *adept*, until his little income was almost entirely wasted in the vain pursuit. Zecaire tells us himself that he did, thank Heaven, finally succeed in forming gold; but whilst on his road to some place in Germany, where he was going to enjoy the fruits of his supposed discovery, the poor fellow met with a mournful end—he was assassinated at Cologne by his fellow-traveller.

After a while what is called the *experimental method* dawned (300 years before the time of Lord Bacon [*]) with that extraordinary genius, Roger Bacon, although Aristotle had alluded to it, fifteen centuries earlier, as the true method of studying nature. In the sixteenth century we find Paracelsus and his contemporary, Bernard Palissy, vigorously propagating this experimental doctrine, and advocating *practice* before *theory*; but even in the middle of the eighteenth these two things were so distant from each other in men's minds that in the public colleges of Paris there was always a *lecturer* and a *demonstrator*. Under Louis XV. the *demonstrator* of the chemical lectures at the *Jardin du Roi* was Rouelle, and his demonstrations were often exactly the opposite of the theory just before propounded by the lecturer.

This Rouelle was a very original personage. We find in him something of Paracelsus and something of Bernard Palissy. He demonstrated very energetically, was apt sometimes to require the assistance of his nephew—his "eternal nephew," as he called him—who was rarely present when wanted. Under these circumstances Rouelle would go himself from the amphitheatre to the laboratory to fetch what he required, continuing his lesson the whole time, and returning to the lecture-room with the exclamation, "Yes, gentlemen, that is what I had to explain to you!" When begged to recommence he would do so in the kindest manner possible, believing that he had not made himself understood. Rouelle was the professor of Lavoisier.

If we follow up, in Dr. Hoefer's work, the history of oxygen gas, we pass certainly through some of the most romantic paths in chemistry. Oxygen was obtained for the first time in a state of purity by Eck de Sulzbach, a wandering alchymist, in 1489, by heating red oxide of mercury. But in those days the means of collecting gases were unknown. The *pneumatic trough* (an invention usually attributed to Priestley, who merely used *mercury* for the first time instead of *water*), by which gases may be collected, was invented and described by the poor Parisian student, Maitrel d'Elément, who published a pamphlet upon it in 1719, after being "snubbed" by the Academy, and dedicated it "to the ladies." These are facts, well established by Dr. Hoefer, with which those who are acquainted with his "History of Chemistry" may be already familiar. The history of oxygen in the hands of Jean Ray, Robert Boyle, John Mayow, Priestley, Schéele, and Lavoisier, and the gradually developed theories of combustion and respiration, form some of the most interesting chapters in this volume. There are also some remarkable paragraphs relating to Lavoisier's unfortunate death upon the scaffold: it would appear that several "distinguished *savants*" of that terrible epoch in French history had it in their power to save the life of this wonderful genius, if they had possessed courage to come forward at the last moment, or had they not been restrained by motives distinct from fear.

The biography of Charles William Schéele is sketched by Dr. Hoefer in a very clever manner, but we have no space to quote from it. Born on December 19, 1742, at Stralsund, he became assistant to an apothecary at the age of 14. It was in the midst of the most obscure occupations that Schéele perfected himself in the study of a science which owes to him more discoveries than to any other man. The history of his career will encourage, for years to come, those whose first love for chemical research is attended with more than ordinary difficulties. In 1786 he married the widow who had given up to him the little pharmacy at Kjöping, which yielded him about 600 francs a year, and died two days after his marriage, at the age of not quite 44 years. The King, wishing to recompense a man whose name was so familiar to him, had his name added to the list of Swedish knights, "but his minister, little acquainted with the *savants* of the day," sent the order to the wrong person—some lucky homonyme.

With this we must take leave, at least for the present, of Dr. Hoefer's very interesting and instructive volume.

T. L. Phipson, Ph.D., F.C.S.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

2719. J. Blaggs, Chancery Lane, "Improvements in the manufacture of inflammable gases, and in their application to useful purposes."—Petition recorded Oct. 21, 1865.

2768. S. Sequelin, Camden Town, "Improvements in the purification and preparation of animal and vegetable wax, stearine, spermaceti, paraffine, and other solid, waxy, or fatty substances."—October 27, 1865.

2786. H. Larkin, Torriano Cottages, Leighton Road, N.W., "Improvements in lamps for the combustion of magnesium, and in preparing magnesium for burning."—October 28, 1865.

2808. H. Y. D. Scott, Ealing, Middlesex, "Improvements in the treatment and deodorisation of sewage water."—October 31, 1865.

2810. J. Sellars, Manchester, "Improvements in the manufacture of artificial gum, size, or stiffening matter."

2818. C. H. Wood, Aldgate, and E. L. Barret, Thrawl Street, Spitalfields, "An improved mode of purifying gas."—November 1, 1865.

2825. L. Schad, Warrington, Lancashire, "Improvements in the manufacture of colouring matter for dyeing and printing."

2833. J. Webster, Birmingham, "Improvements in generating and applying certain gases, and in apparatus to be employed therein."—November 2, 1865.

2835. H. Bessemer, Queen Street Place, New Cannon Street, London, "Improvements in the manufacture of iron and steel, and in apparatus employed in such manufactures."

2838. J. B. Elkington, Newhall Street, Birmingham, "Improvements in the manufacture of copper from copper ore."—November 3, 1865.

2853. J. Thys, Grove Road, Mile End, "An improved non-conducting composition for preventing the radiation or transmission of heat or cold."—November 4, 1865.

2859. A. Paraff, Manchester, "Improvements in printing and dyeing textile fabrics and yarns."—Nov. 6, 1865.

2867. D. Barker, St. James's Street, Piccadilly, "Improvements in the manufacture of bricks and artificial stone and marble."—November 7, 1865.

Notices to Proceed.

1766. John Dale and R. S. Dale, B.A., Manchester, "Improvements in the production of pigments suitable for printing upon paper and woven fabrics."—Petition recorded July 4, 1865.

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[*] Baron Liebig's admirable study of Lord Bacon as a man of science, published some months ago in *Macmillan's Magazine*, will tend to modify the general opinion entertained in England of this singular man's *experimental* (?) philosophy.

CORRESPONDENCE.

New Iron Ore.

To the Editor of the Chemical News.

Sir,—Permit me, through your columns, to draw the attention of your readers to what appears to myself and others to be an undescribed ore of iron. It has much of the characteristic appearance of plumbago, and leaves a black greasy stain when rubbed between the fingers. It is comparatively soft, and when scratched with a knife falls off the mass in beautiful shining particles, having a metallic lustre and not unlike powdered mica. This mineral is said to have been obtained in Ireland, near the surface, underlying about fifteen feet of peat. Its analysis gives the following percentage:—

Insoluble (in HCl and NO_5)	9·5
Ferric oxide	90·5
	100·0

This mineral is quite unacted upon before the blowpipe, and contains no carbonaceous matter whatever. I enclose a small fragment for your inspection.

I am, &c. Jno. Sutherland.

314, Duke Street, Glasgow, November 21.

Notes on the "Analysis of the Phosphatic Rock recently Discovered in Wales, by Dr. T. L. Phipson."

To the Editor of the Chemical News.

Sir,—In this paper Dr. Phipson tells us that a "deposit" or "lode," he does not say which, of phosphatic material has lately been discovered in Wales, and that to supply the want of an analysis in a memoir by Prof. Voelcker on this subject he gives us several analyses of his own, made for, and published with the permission of, some gentlemen, probably a firm of artificial manure makers, at Wolverhampton, whom, doubtless much to their astonishment, he describes as "eminent agricultural chemists." Having effected this transformation, Dr. Phipson next converts, it is to be presumed by metamorphic action, the "deposit" or "lode" into a "rock," which shortly afterwards becomes a "vein," for he proceeds to further enlighten his reader in this manner, "In nature this phosphatic rock forms a wide perpendicular vein between clay-schist and pipe-clay, and in the neighbourhood of a dark bituminous limestone." It is possible to form a guess as to the meaning of this sentence; but if interpreted according to its construction, one stumbles hopelessly. It may be presumed that the learned chemist means that this mineral occurs as a vein lying between beds of schistus and pipe-clay, and that a dark bituminous limestone is to be met with close at hand. He then gives no less than four analyses of this substance, which, considering that they appear in a scientific journal, are striking examples both of confused and of unfinished work. In each of these analyses a very considerable proportion of the constituents, varying from 2 to 14½ per cent., remains undetermined, being huddled together under one head, as "carbonate of iron, carbonate of lime, and matters not determined." Again, in the two first analyses, the chemist combines the constituents of the mineral, whilst in the two last he gives these constituents separately, permitting the reader to combine them at his leisure. In no instance does he describe the method pursued in these analyses, so as to render it possible to form a judgment of their probable correctness; and not until the conclusion of his paper does he afford any insight to the reason why he regards the alumina as existing in the form of silicate rather than that of a phosphate of this earth. From such analyses, with from 2 to 14½ per cent. of undetermined elements, the author labours to construct chemical formulæ descriptive of this phosphate, and in so doing has employed symbols which, though not new, have probably never before found themselves conjoined. Not satisfied with this little eccentricity, the author proceeds to exercise his metamorphic force upon one of these symbols, since the fe in one line is converted in the next into Fe—a change possibly unimportant in his eyes, but which, in a symbol, a thing demanding the utmost exactness of expression, must lead to the conclusion that two distinct compounds are signified by these differences.

It would be well, and, indeed, only becoming, that before Dr. Phipson and others of his stamp appear in print, they should consider whether a few rough and incomplete commercial analyses are worthy the attention of any but those who have a pecuniary interest in the matter, and also whether they are justified in placing the results of their crude experiments and deductions therefrom before the public, especially when conveyed in language so careless, confused, and obscure as that of the paper which has provoked these notes.

I am, &c., J. Denham Smith.

MISCELLANEOUS.

The New Chemical Professorship at Oxford.—Sir Benjamin Brodie, Bart., M.A., has been appointed Waynflete Professor of Chemistry at Oxford. This appointment will render vacant the Aldrichian Professorship of Chemistry, which will not be filled up now. The friends of science at Oxford are still few in number, and even these, we are afraid, do not put out all their strength. From the proceedings of a recent meeting to consider a proposed extension of the University, it would appear that a majority in Convocation are still disposed to regard the University as a manufactory for priests. The Vice-Chancellor, we think it was, said that they did not "want more *apothecaries* and attornies." Under the former designation we suppose the reverend gentleman would include all those students who would devote themselves more particularly to the natural sciences. But to return: should the Aldrichian Professorship not be filled up, we must again insist that the funds would be best employed in establishing chemical scholarships or fellowships which, like the Radcliffe, should only be held for a limited number of years.

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. Private letters for the Editor must be so marked.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

M. P. S.—See present number. Our reporter mislaid his notes.

Dr. Muspratt.—Declined, with thanks.

R. L. S.—We have had no experience in the use of Bunsen's battery with bichromate of potash and sulphuric acid.

G——e Low.—Next week.

Thallium.—It has only been done indirectly by the use of soda waste, which contains a considerable proportion of lime. The use of carbonate of lime is patented in England.

X., Subscriber.—There is no colourless *salt* of rosaniline that we know of. The colourless base is precipitated from a salt on the addition of an alkali. The best account of aniline, &c., is to be found in Dr. Hofmann's Exhibition Report. A full abstract of the part relating to the dyes will be found in a series of articles in Vol. IX. of the Chemical News.

Books Received.—"Fresenius' Quantitative Analysis," edited by J. L. Bullock and Arthur Vacher; "Cholera Prospects," by Tilbury Fox, M.D. Lond. (Pamphlet).

Received.—"Formula."

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Analysis of a Fresh-water Fossil (Unio) from the Coal Measures, by Dr. T. L. Phipson, *F.C.S., &c.*

The fossil of which I have just made the analysis is found near Tipton, South Staffordshire, in some pits belonging to one of my friends. I believe it is the first time that any of these fossils have been submitted to careful analysis, and the result is rather remarkable.

The species in question belongs to the genus *Unio*; it is probably the *Unio Urii, Flem.*, but the exact determination is of little consequence here. An allied species has been figured by me in my recent work, "The Utilisation of Minute Life," p. 191. It is sufficient to note that all the mollusca of this genus are fresh-water mollusca, and that the deposit in which they are formed is a fresh-water formation. The bivalve in question has given me the following composition:—

Carbonate of iron	74·55
,, lime	6·20
,, magnesia . . .	3·20
,, manganese . . .	1·00
Phosphoric acid	0·20
Silicate of alumina	13·50
Water	1·20
	99·85

It has, therefore, the composition of the South Staffordshire iron ores—*i.e.*, of the spathic iron ores of the coal formations. We could not have greater proof that these vast deposits of iron ore, to which England owes so much of her commercial and industrial prosperity, must be looked upon by the geologist as fresh-water formations. Deposited, doubtless, in the first instance, as hydrated peroxide of iron, like the bog-ore now forming in the Swedish lakes, which (as I have shown elsewhere) swarms with minute organisms, and afterwards reduced to the state of carbonate of protoxide by the constant presence of organic matter in a state of decomposition.

Recovery of Pure Silver from Photographic Residues, by Dr. Van Monckhoven.

1. **From Old Baths.**—First filter then add ammonia until the precipitate first formed is re-dissolved; then add sulphite of ammonia, or pass a current of sulphurous acid gas. Afterwards heat the liquor to about 104° F. for about an hour, when all the silver will be precipitated in a state of absolute purity. This method was first suggested, I believe, by M. Stas. After washing the silver a powder obtained as above may be at once dissolved in nitric acid to form nitrate.

2. **From Washings.**—The washings may be collected in a barrel in which a sheet of copper is placed. The silver will be precipitated in about twenty-four hours. When the liquor has been often renewed, and a quantity of grey powder of silver has collected, it may be dissolved in nitric acid, and treated with ammonia and sulphite of ammonia as above.

3. **From Paper.**—Burn the papers one by one so as to get a white ash. Weigh the ashes and treat them with an equal weight of nitric acid diluted with twice its volume of water. All the silver will be dissolved. Filter, and pour the solution into the barrel containing the sheet of copper. Treat the precipitated silver as before.

4. **From Chloride of Silver.**—This may be at once dissolved in ammonia and treated with the sulphite. The silver will be precipitated quite pure.

The method is not applicable to old hyposulphite. In all other cases it is easy to follow, and furnishes chemically pure silver. Every salt of silver dissolved in ammonia and treated with the sulphite is reduced. In liquors heated as directed to 104°, the precipitation is completed in about half an hour; but in the cold, twenty-four hours are required, at the end of which time the precipitation is perfect.—*Bulletin Belge de la Photographie.*

Researches on the Influence of the Electro-negative Elements on the Spectra of Metals, by M. E. Diacon.*

(Continued from page 245.)

It was mentioned in the last number that all metals do not lend themselves equally well for the kind of researches described. Chlorides of metals, for example, which give a spectrum with the chlor-hydrogen blowpipe, give ordinarily very characteristic lines, but these are often very transient, and are wanting in definition. Notwithstanding their transitoriness, however, they may sometimes give useful indications. Certain metals—such as manganese, zinc, cadmium, &c., always give the same spectrum, whatever may be the compound employed.

The metals which give the best defined results with the haloids are the alkaline-earthy metals, and bismuth and copper. In the experiments about to be described, a gas blowpipe, the blast for which was supplied by a trompe, was used instead of a Bunsen's jet. The flame obtained by this means is narrower, more equable, better directed, and gives no spectrum in the upper part. It also enables the experimenter to operate at different temperatures by regulating the supply of air. With such an apparatus bromide of barium gives a spectrum which differs from that of the metal, by showing the second and third green lines (the lines are always counted from the red to the violet) with much greater brilliancy; with the chloride the increased brilliancy is observed in the third and fourth lines. With bromide of strontium there is seen beyond the fourth red line, a line which belongs neither to the spectrum of the metal nor to that of the chloride.

Bromide of calcium shows two new red lines. With bromide of copper a spectrum of great brilliancy is obtained, which differs at once from that of copper and also of the chloride.

Iodide of barium gives, at the instant it is introduced into the flames, two green lines; one very brilliant but very transitory, and less refrangible than the first green line of baryta; the other partly coinciding with the second. With the iodides of strontium and calcium the differences are not so remarkable.

The spectrum of iodide of copper is very beautiful; it presents parts common to the spectra of the chloride and the bromide, but is distinguished from these by the position of the lines more refrangible than the green. Those lines extend much further towards the violet than is indicated in a plate given by Mitscherlich. The iodide of bismuth gives a spectrum generally bathed in diffused light, except in the violet. It differs less from that of bismuth itself than those of the chloride and bromide, but is distinguished by the beautiful indigo line which terminates it. The spectra of bismuth itself, and those of the chloride and bromide, do not extend so far towards the violet.

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* Abridged from *Annales de Chimie et de Physique*, Sept., 1865.

The fluoride of barium[†] gives a spectrum showing six green lines, nearly equidistant; this appearance is owing to the presence of two new lines more refrangible than those belonging to the metal. These two lines appear alone at the first moment, and their brilliancy may be increased by introducing into the flame below the test specimen an easily decomposable fluoride which gives no spectrum.

The fluoride of strontium also shows a new line, well-defined, but not brilliant, and having rather less refrangibility than the yellow sodium line. Fluoride of calcium is characterised particularly by a beautiful green line, almost as brilliant as the green line of calcium; it is situated a little beyond the thallium line. The double orange is the most brilliant presented by the spectrum of this fluoride. The fluoride of bismuth and copper give no spectrum.

The attentive study of the light emitted by the bromides, iodides, and fluorides demonstrates, then, that the introduction of those salts into a flame determines the appearance of lines which do not exist either in the spectrum of the metals or in that of the chloride. We must, therefore, conclude that these compounds, like the chloride, have peculiar spectra, the superposition of which on that of the metal gives the appearance observed in each of them.

From the foregoing experiments we learn that spectrum observations give us the means of determining not only the metal but the electro-negative element combined with it. Unfortunately, very definite results are only obtained with a few of these compounds. Although the spectra of the chloride and bromide of copper are very much alike, it is easy to distinguish one from the other. The part up to the division 130 of the micrometer is almost identical, because of the superposition of the spectrum of copper, which is unavoidable in an oxidising flame. But the lines between 130 and 150, as well as those seen in the indigo and violet, show differences in the two spectra easily to distinguish without having recourse to measurement. For example, the position of the greenish blue lines is characteristic of the bromide, that of the violet lines for the chloride. When the two salts are placed in the flame simultaneously, the green lines of the bromide predominate at the first instant; the first of the double indigo line of the chloride is visible; the superposition of the more refrangible rays of the two spectra give rise to new appearances. The presence of the iodide of copper produces no change of importance; and thus it is easy to recognise at least a chloride and bromide in a mixture of the three salts.

Iodide of bismuth gives the clearest indication of iodine; the spectrum of the salt up to 130 is often ill-defined and difficult to distinguish from the same part of the bromide and chloride spectrum; but the beautiful violet band which terminates that of the iodide is a convincing proof of the presence of iodine.

Fluoride of calcium must always be used to show the spectrum of fluorine. The green line situated about 121 is very brilliant when a very high temperature is employed, and may be considered characteristic of this metalloid.

In conclusion, the author recommends in some cases precipitation with nitrate of silver, but instead of using the silver precipitated in the manner directed by Mitscherlich (p. 243), he treats it with sulphuretted hydrogen, saturates one part of the acid liquor with oxide of copper, and the other with freshly precipitated oxide of bismuth. The liquid or the dry residue of evaporation may be tested directly in the flame, the one for chlorine and bromine, the other for iodine as indicated above.

Lastly M. Diacon repeats that the spectra given by Kirchhoff and Bunsen for the alkaline-earthy metals are a mixture of the spectra of the oxide and the chloride, as are also the spectra given by Mitscherlich as those of the chlorides. In the former, he says, the spectrum of the oxide predominates; in the second that of the chlorides. A metal, he states, may give different systems of lines, according to the experimental conditions or the nature of the compound experimented upon, and no absolutely specific character can be attached to the spectra given by Kirchhoff and Bunsen: they can only be considered characteristic of the conditions under which they were observed.

PHARMACY, TOXICOLOGY, &c.

On Veratrum Viride, by CHARLES BULLOCK.

THE sedative action of veratrum viride has been so well attested by the experience of medical practitioners, that its therapeutical claims have been acknowledged by placing two preparations of the plant in the present Pharmacopœia of the United States. A number of examinations, to determine the chemical constituents of the root of veratrum viride, have resulted in the isolation of an alkaloid which answered in general character to veratria.

The paper of Mr. G. J. Scattergood, read before the American Pharmaceutical Association in 1862, showed that the principle supposed to be veratria was associated with a resin possessing greater effect in reducing the force and frequency of the pulse than the alkaloid itself. Dr. Percy's experiments with a sample of purified commercial veratria demonstrated that principle to possess less sedative action than the resin associated with the veratria of veratrum viride. Mr. Scattergood found the resin precipitated from the tincture of veratrum viride after treatment with ether, to possess sedative action to a remarkable degree. As the subject is open to further investigation, the following notes of an examination of the root may perhaps add something to the sum of our information regarding its active constituents.

Profiting by the experience of former investigators, the following process was adopted for procuring the active principle of the plant:—

A fluid extract was prepared according to the formula adopted in the last edition of the United States Pharmacopœia—viz., thirty-two troy ounces of the root in powder moistened with twelve fluid ounces of alcohol, was introduced into a percolator, and alcohol gradually poured upon it until a pint of tincture had passed. This was set aside, and the percolation continued until five pints more of tincture were obtained. This was distilled to one pint and mixed with the reserved tincture.

To the fluid extract (which was slightly acid to test-paper) sufficient acetic acid was added to give a distinct acid reaction, and the extract poured into one half-gallon of water with constant agitation. The mixture was allowed to stand for twenty-four hours, when the resin was collected on a cloth filter. After distilling the alcohol from the solution, evaporation was continued until it was reduced to one pint; it was then filtered

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[†] All the haloid salts must not be examined with the same flame. A high temperature is necessary for the fluorides, but a less heat serves better for the bromides, and especially for the iodides.

through paper to separate the remaining resin, two ounces of alcohol added, and carbonate of soda to decided alkaline reaction. The addition of alcohol was found advantageous in preventing the precipitation of colouring-matter with the impure principles. On adding the carbonate of soda to slight alkaline reaction the solution became dark and opaque, further addition of the carbonate of soda increased the precipitation, and the solution assumed a clear wine-red colour.

The precipitate was collected on a filter, washed slightly, dried, dissolved in alcohol, and digested with purified animal charcoal. The alcoholic solution left, on evaporation, a dark brown resin; this residue was dried and treated with water acidulated with sulphuric acid, using a gentle heat to promote the solution. On cooling, the solution became turbid, and deposited a flocculent precipitate, which proved to be chiefly colouring matter. When cold, the solution was filtered, and precipitated by carbonate of soda. The precipitate was collected on a filter and washed till the filtrate passed without colour, when it was again dissolved in water acidulated with sulphuric acid and digested with animal charcoal on a water bath.

[On adding to a portion of this slightly acid solution in a test-tube an equal volume of alcohol, to ascertain if any lime salt was present from the charcoal, of the purity of which I was not confident, the solution became very turbid, and, on warming, deposited a copious precipitate. Examination of the clear fluid, after removing it from the precipitate, showed it to be almost entirely free from organic salts; the precipitate contained nearly the whole of the alkaloids with the lime salts. This phenomena I have not seen noticed in the books, and may prove important in investigations for vegetable principles.]

The solution of the sulphates was again precipitated with carbonate of soda, the precipitate washed to remove the excess of alkaline carbonates, and dried on a water bath at a moderate heat. The product thus obtained represented the basic principles of veratrum viride mixed with some lime salts. To effect a farther purification, the product was reduced to powder and agitated with successive portions of ether free from alcohol. The ether left on evaporation a light yellow residue, weighing 9·2 grains; it had no disposition to assume a crystalline form, and detached itself from the glass capsule in scales resembling tannin.

The portion insoluble in ether was then treated with alcohol of 95 per cent. The product from the alcohol weighed 15·7 grains; it was semi-resinous in character, and of a light buff colour.

Both products still retaining some colour, a portion of each was dissolved separately in alcohol, and digested with animal charcoal, this treatment failing to decolorise them; the alcohol was evaporated and the residue dissolved in acidulated water, filtered, a small amount of alcohol added, and precipitation effected by very dilute ammonia. Both precipitates (which were now colourless) were collected on paper, well washed, and dried. The product soluble in ether dried to a soft pulverulent condition; the other assumed a hard semi-resinous form, adhering to the filter.

Examination of the Products.—The alcoholic solutions of both principles restored the colour of reddened litmus paper. They are slightly bitter to the taste, and dissolve freely in dilute sulphuric, nitric, hydrochloric, and acetic acids. The product soluble in ether is powerfully sternutatory, the other much less so.* An alcoholic solution of the two principles dropped on glass slides and examined under the microscope showed no disposition to crystallise, but dried to an amorphous powder. Both are soluble in alcohol, amylic alcohol, and chloroform. Neither of them, after drying, dissolve in benzol.

[Mr. J. G. Richardson found the product soluble in ether to dissolve in benzol immediately after separation from its acid combination, a property which characterises other alkaloids—as, for instance, morphia and strychnia, in Stas' method for the detection of the poisonous alkaloids, where ether is used as the solvent.]

Alkalies and Alkaline Carbonates precipitate both alkaloids from their solutions; the precipitate is insoluble in an excess of the precipitant. The precipitates are flocculent, and, when examined from time to time during twenty-four hours under an 8-10th object glass, showed no disposition to assume a crystalline form. Bicarbonate of soda does not precipitate a slightly acid solution, even when added to distinct alkaline reaction. Heating determines the precipitation. Sulphocyanide of potassium, no precipitate in dilute solutions of either principle. Perchloride of gold, a precipitate with both. Iodohydrargyrate of potassium, a copious white precipitate in both solutions. When treated with concentrated sulphuric acid, both alkaloids give nearly the same reaction—viz., dissolving to a reddish yellow colour, which changes to ochry red, then to reddish brown, and finally becoming brown. [Veratria changes from light yellow to bright blood red, then crimson, which latter colour lasts for some hours.]

The solutions of the alkaloids in sulphuric acid, treated according to Erdmann's method of colour testing—with sulphuric acid containing a trace of nitric acid, and afterwards adding a fragment of binoxide of manganese—comported themselves differently from veratria; varying but little from the action of sulphuric acid alone. In nitric acid both dissolved to colourless solutions, showing after a few minutes a faint and evanescent rose tinge. This reaction was not, however, very decided. In strong hydrochloric acid both dissolved in the cold to faint yellow solutions; boiling deepened the colour. After standing twenty-four hours, the solutions assumed a turbid greenish colour.

[Veratria, as was shown by Trapp in 1863, dissolves to a colourless solution in cold hydrochloric acid; when boiled it assumes a red colour, that finally becomes intense, resembling that of permanganate of potassa.] This reaction is very sensitive, even with the impure veratria of commerce,—the colour remaining with little change in a closed test tube, after the lapse of ten days.

Fusibility.—The alkaloid soluble in ether fused at 270° to 275° F.; the other at 335° to 340° F. [Veratria, according to Soubeiran, fuses at 115° C., = 238° F.

The therapeutical effects of the two products have been so fully described by G. J. Scattergood that a confirmation of them seems to be unnecessary. What was described by him as a resin, my experiments tend to show is a distinct base; and to which Mr. Scattergood ascribes much more potency in its effects upon the circulatory system than to the alkaloid isolated by himself and others. The reactions of both these principles with sulphuric acid carefully repeated, and with hydrochloric acid, tend to the belief that neither of them is veratria, properly considered, although this, and the deportment with other reagents, show a close connexion between

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* Half a grain of powdered opium, used as a snuff, quiets in a few minutes the excessive irritation of the mucous membrane of the nose.

them. Whether the product insoluble in ether is analogous in like manner to veratrin, I am unable to inform myself, as I know of no account of the deportment of that principle with reagents.

The experiments of Dr. S. R. Percy (Chemical News, August 20, 1864), differed from my own in some particulars, so important, especially regarding the precipitated alkaloid assuming a crystalline form after some hours, that I repeated the trial under different forms, using different precipitating solutions—as potassa, carbonate of potassa, and ammonia—but always with the same result, as before stated.

The resinous matter precipitated by pouring the fluid extract into water, I have set aside for a future examination.—*Amer. Jour. of Pharmacy.*

PROCEEDINGS OF SOCIETIES.

SOCIETY OF ARTS.

CANTOR LECTURES.

"On some of the most important Chemical Discoveries made within the last Two Years."

By Dr. F. Crace Calvert, *F.R.S., F.C.S.*

Lecture 2.

(*Continued from page* 249.)

Whilst on the question of the combustion of coals, and of smoke, allow me to draw your attention to a clever invention by Mr. Snook, of Manchester, which he calls an "invigorator." The invention may briefly be described as an apparatus placed within the semicircle forming the upper portion of an ordinary register fire-grate, formed entirely of cast-iron, and so constructed as to be readily applied to all existing grates known as of the register form. In experiments which have been made, it has been proved that after lighting the fire (the whole of the apparatus being closed, so as to act as a blower) a brisk bright fire is produced in about four minutes. A large concave elliptical plate immediately over the grate bars, suspended on end pivots, is tilted over to an angle of about 70°, when it is seen that the back or concave portion of the plate acts as a bright reflector, throwing out the heat rays into the room, instead of allowing them to pass up the chimney. Two horizontal plate doors or louvres, above the reflector, are next opened, when the draught is found to be reduced to the smallest amount compatible with the continuance of combustion in the grate. The heat thrown out from the fire is considerable, and the fire itself forms a pleasant object to look at, having a warm red glow, without either flame or smoke proceeding from it.

The next invention I wish to call your attention to is one which, like that of Mr. Siemen's, is calculated to render marked service to society. It is the production of motive power through the combustion of coal gas, and you will, I hope, appreciate the discovery due to Mr. Lenoir if you call back to memory the efforts which have been made for the last twenty or thirty years to generate power by employing the expansion which air or other gases undergo under the influence of heat as a substitute for steam—the long-promised success and the unfortunate failures of Ericsson. What especially recommends the engines of M. Lenoir is their safety, for there is no danger of explosion; their cleanliness, for they require no fuel; their simplicity, which enables those who employ them to use them in any room at any height and at any spot where motive power may be required, for they have only to erect a little engine of one or two horse power, and whenever they require to use it all they have to do is simply to bring into contact two poles of a battery, when the fluid so generated will traverse space and convey motive power to the gas engine. Lastly, these engines are extremely economical in their working, for they consume only 70 feet of gas per horse power per hour; and assuming that 1000 feet of gas is worth 4s. 6d., the cost of working an engine of one-horse power will be about 4d. per hour. M. Lenoir's engine is very similar to the ordinary steam-engine, having a cylinder, piston, crank-shaft, and fly-wheel. The following proportions of gas are admitted in the cylinder:—One volume of coal gas mixed with twelve volumes of atmospheric air. This mixture is ignited by the electrical spark from a battery connected by wires at each end of the cylinder. The connexion being made and broken by the rotatory action of the crank-shank, the expansive force necessary to move the piston of the engine is produced by the ignition of the gas, which not only produces steam and carbonic acid by their combustion, but by the heat generated increases their volume to a sufficient extent to force the piston to travel backwards and forwards, thus producing motion. The engine once fixed, the battery charged, and the gas turned on, it is ready for action, and as soon as the work required is completed the gas is shut off, the engine stops, and the expense ceases.

The facility for employing Lenoir's engine in countries where coal is not easily attainable has been increased by substituting for coal gas a mixture of oxide of carbon and hydrogen, which can easily be procured on a commercial scale at a small cost by passing steam over heated charcoal, the water being decomposed, its hydrogen being liberated, and its oxygen combining with the carbon itself produces oxide of carbon, and the mixture of these gases is a cheap and good substitute for coal gas. Consequently M. Lenoir's engines can be employed with great advantage in our British colonies and in South America.

I shall now have the pleasure of calling your attention to an interesting and valuable invention of one of the most learned and eminent chemists of England, Dr. J. Stenhouse, F.R.S., who has devised quite a new method of waterproofing vegetable and animal tissues and fabrics. Previously to his discovery, the modes of waterproofing consisted in using bees' wax and various kinds of drying oils, such as linseed, the siccation of which is enhanced by boiling them with peroxides of lead or manganese. Further, you are all aware of the extensive use which has been made of caoutchouc and gutta-percha for waterproofing purposes. Dr. Stenhouse's waterproofing material is a white solid substance, having no odour, undergoing no change through the action of the atmosphere, and which has acquired of late great popularity, by the application which has been made of it as an illuminating and lubricating agent. I mean paraffin, the discovery of which, in a commercial point of view, and its introduction into public notice, are due to Mr. James Young, of Bathgate, near Glasgow, who has now established one of the largest manufactories in the world for the production of this article, notwithstanding it was considered a commercial novelty in 1852. Dr. Stenhouse found that if he employed pure paraffin for waterproofing, owing to its tendency to crystallise, it would not adhere sufficiently to fabrics. He, therefore, conceived the happy idea of adding to it a few per cent. of linseed oil, which overcame the defects presented when paraffin was employed alone, effecting a better adhesion between the waterproofing material and the textile fabrics, and rendering leathers more flexible. Dr. Stenhouse melts together paraffin oil with a few per cent. of linseed as above stated. He runs the whole into cakes, and in order to apply this waterproofing agent he heats the cake and rubs the materials over with it or spreads the melted mixture over the fabric by means of a brush. His process is applied with great advantage by Messrs. Silver and Co., to the waterproofing of soldiers' tents, and other materials of that class, to the great comfort of the soldiers; for, without increasing the weight of their tents, it renders them impermeable, and protects the men from rain and its attendant discomfort and danger. Another most useful application of Dr. Stenhouse's waterproofing material is the rendering of leather impermeable; by examining the specimens, you will immediately see the immense advantage that cavalry will derive from having their saddles rubbed over with this preparation, as it renders the leather incapable of absorbing moisture, and enables the soldier to mount his horse after heavy rain with as much comfort as if it had remained under shelter. It also renders the soles of shoes quite impermeable, and at the same time communicates to them great flexibility, so that the boots of navvies and other similar articles are rendered far more useful and durable, as we all know that the constant wetting and drying of leather expedites in a marked manner its decay. There is one more application of Dr. Stenhouse's waterproofing to which I should wish to call your special attention, as it is of interest to the manufacturers of Manchester and of Lancashire generally. In those districts, large quantities of what is called waterproofing materials are used in packing the goods, and preserving them from external wet or injury. Many of these materials are made by covering a coarse calico fabric with a coating of boiled linseed oil, but this class of packing is very imperfect, and loses its strength rapidly, especially in hot climates, owing to the fact that the boiled oil absorbs oxygen, and carries it on to the fibre, oxidising it, and thereby soon destroying its tenacity. By applying Dr. Stenhouse's process to the fabric previously to the drying oil, not only is great impermeability attained, but the fibre, being saturated with paraffin, is preserved from the subsequent oxidation which it would undergo under the influence of the atmosphere in the presence of the boiled oil alone.

I should have wished to have dwelt at some length on the interesting application which has been made of late years, especially on the Continent, of another coal product, which, like most of those whose origin is due to coal, has received many valuable and beautiful applications. The one I now refer to is called bisulphide of carbon, and is applied with great success not only to the extraction of fatty matters from various seeds and fruits, such as olive, linseed, &c., but in Algiers for extracting from flowers various essential oils, commonly called perfumes, such as essence of roses, lavender, jasmine, &c. You will, no doubt, remember also the useful application which bisulphide of carbon receives in the hands of Messrs. Allbright and Co., of Birmingham, in separating the common phosphorus from the red or amorphous phosphorus now applied to the manufacture of chemical matches, as explained to you in my first lecture of last year's course.

I cannot conclude what I have to say respecting coal products, without stating the fact that, since I had the honour of delivering a lecture in this room, in 1862, many beautiful and valuable discoveries have been made in connection with coal-tar colours. Dr. A. W. Hofmann has succeeded in obtaining some magnificent purples, by a process as curious as it is highly scientific, and such as might be expected from so talented a chemist. Since then a splendid green colour, called verdine, and which has the curious property of retaining that colour in artificial light—yea, more than that, of increasing in beauty in the presence of that light—has been discovered by M. Eusebe. A beautiful fast black, easily applicable to the art of calico printing, has also been devised; and lastly, in the hands of Messrs. Simpson, Maule, and Nicholson, the well-known colour called magenta, and a beautiful blue called opal, have not only been much increased in beauty, but their cost of production has been materially reduced. In fact, at the present day, every shade of colour is produced from coal tar products; but the subject is too vast for me to attempt now to enter into details as to their mode of production and application.

As the hour is advancing, I must, though with regret, leave the interesting subjects which have reference to coal and its products, and pass to another class of manufacture. The first of these has reference to the refining of sugar, and among the several improvements which have been effected in this branch of manufacture during the last few years none is more important in its general bearing than that recently brought to the notice of the public by Mr. Alfred Fryer, of the well-known firm of Fryer, Benson, and Foster, of Manchester. This gentleman has published some valuable information on the composition of the sugar-cane juice, and the alterations it undergoes under the influence of heat and atmospheric air, and has conferred on the colonies a great boon by inventing an apparatus which will effect a great saving in obtaining sugars. Mr. Fryer's experiments on the cane juice teach us that, instead of only extracting 49 per cent. of the juice, as is usually the case, when the canes are worked by the old system, 61 per cent. can be obtained with a good steam engine having 24-inch rollers; and by pressing the megass a second time through the rollers as much as 70 per cent. can be obtained; and Mr. Fryer does not doubt that even 80 per cent. may be reached, if more attention is paid to the pressing of the canes through the rollers. Mr. Fryer has also published some interesting facts on the action of the oxygen of the atmosphere on cane juice. Thus he has observed that the juice rapidly darkens, and that this increase of colouration is not only an indication that the juice is undergoing deterioration, but that no amount of defecation will subsequently remove this colouration. He has further noticed that cane juice rapidly becomes acid, and the acidity increases also in a very rapid manner. He gives an instance—a pattern of too many others—where the juice, after expression, flowed down a spout 250 feet in length, from the mill to the boiling-house, occupying in its descent about half-a-minute. The amount of acidity increased from 100 to 253, and the colour deepened fourfold.

Mr. Fryer has also published some very interesting facts on the influence of heat on the cane sugar, and I here take the liberty of extracting from a paper of his the following facts:—

"We now come to the boiling. All heat above 140° is capable of exerting an injurious effect. As regards the time this effect is proportionate to the duration of the heat; the continuance of any syrup for two hours at any given temperature would cause just double the mischief which would be produced by its continuance at the same temperature for an hour. But as regards the heat, the mischief increases about as the square of the difference from 140° the highest innocuous temperature. So at 160° during any given time a certain degree of mischief would be done. To keep the same syrup for the same time at the heat of 180°, would give four times the mischief; at 200°, nine times; the difference of 180° from 140° being twice as great as that of 160°, and that of 200° being three times as great."

This mischief consists partly in the change of colour, partly in the change of a quantity of cane sugar or sucrose into fructose. Both these kinds of sugar are present in all neutral saccharine solutions. Sucrose is the ordinary crystallised cane sugar; fructose exists more especially in some kinds of fruit, such as grapes, gooseberries, cherries, oranges, &c., which refuse to form well-defined crystals. Further, I should remark that, under the influence of heat, as just stated, cane sugar or sucrose, is converted into grape sugar or fructose, and that the presence of fructose interferes in a most extraordinary manner by preventing the free crystallisation of sucrose. Thus, for example, every particle of fructose in a mixed solution detains from crystallisation its own weight of pure sugar. In fact, it would be impossible, after mixing equal weights of loaf sugar and fructose in a solution to recover the former in a crystalline state. The change produced by the atmosphere alone, without the action of heat, shows the necessity of proceeding instantly to raise the temperature to the boiling point, and the concentration should be continued without loss of time. The temperature should not, however, be raised beyond the lowest effectual heat.

I will now call your attention to Mr. Fryer's "concretor," as he terms the apparatus.

From the further end of the cylinder a pasty mass is discharged, and, in cooling, it hardens into a non-crystalline homogeneous substance likely to be long known as Fryer's "concrete." Its material is simply cane juice deprived of its vegetable albumen and water, and, not being contaminated by molasses or caramel, is admirably fitted for the operations of the refiner, and will, therefore, command his attention. Allow me, further, to add that his process is easy to conduct; the apparatus, as you see, is simple and self-acting, not liable to derangement; that it performs a large amount of work; and therefore proves a material saving to the sugar producer. I cannot conclude my remarks on Mr. Fryer's invention, as applicable to the colonies, better than by repeating here the words expressed by the Governor of Antigua, who said, "I believe firmly that you have opened a new era of prosperity to our colonies, and heartily wish you abundant success in the course on which you have entered." As to the advantages which a sugar refiner in this country will derive from employing Mr. Fryer's "concrete," instead of having to refine the molasses and coarse sugars usually imported into this country; they are so obvious that it would be really a loss of time to enlarge upon them. The saving to the refiner in having nearly pure sugar to operate upon, and not having to contend with the removal of colour, converted sugar, caramel, and other impurities, will at once convince you of the support and approbation the article will receive from the sugar refiner.

If, at the commencement of this lecture, I drew your attention to the value of intense heat produced at a small cost so as to enable our manufacturers to carry on their various processes, it now becomes my duty to inform you that, of late years, the cheap production and application of low temperatures has become a necessity, especially since organic products have been manufactured on an extensive scale. Three different machines for obtaining these low temperatures have been brought to public notice, viz.: First. That of Mr. Kirk, who has applied in a beautiful manner some of the physical laws discovered by Dr. J. P. Joule and Professor W. Thomson, in their researches on the mechanical theory of heat. Thus, Mr. Kirk succeeds in producing a low temperature by condensing under high pressure atmospheric air, which, on being allowed to resume its primitive volume, produces cold, for the compressed air cannot resume its primitive volume without the essential element for its expansion, namely, heat; and if the apparatus is properly contrived, which is the case in that of Mr. Kirk's, the heat necessary for the expansion of the compressed air is supplied to it by the body whose temperature is to be lowered. Although the construction of this machine is exceedingly costly, still it has been employed at Mr. James Young's works at Bathgate with great success to the cooling of paraffine oil to extract from it the solid paraffin which it contains. The second apparatus is that of Messrs. Harrison and Co., of London, who employ ether as the medium for producing low temperatures. The third is that of M. Carré—in my opinion the cheapest and most practicable apparatus yet invented for the purpose, the more so that it is applicable for household as well as for manufacturing purposes. Although I, like many of you, have witnessed the production of ice by it at the late Exhibition, still I was not prepared to learn that it could be applied with economy to the extraction of some of the salts existing in sea water. Still such is the fact. M. Balard, a well-known French chemist, after many years' study and labour, succeeded in extracting from sea water two products which play a most important part in most of our large chemical works—viz., sulphate of soda and chloride of potassium. To produce the first under ordinary circumstances, extensive works are required, such as are found at St. Helens and Newcastle-upon-Tyne, where thousands of tons of common salt are acted on by vitriol, which gives rise to muriatic acid and sulphate of soda. As to the salts of potash, the French as well as ourselves are dependent for it upon the forests of Russia and the native forest of Canada. By M. Balard's discovery France will free itself from a dependence upon foreign supplies for the potashes she may require as well as the sulphur, and will also do away with the public nuisance—namely, the conversion of common salt into sulphate of soda. Without entering here into details, let me state that M. Balard operates as follows:—In the early part of the spring season considerable quantities of sea water from the Mediterranean are run into large shallow reservoirs. In the summer season the water evaporates, a certain proportion of common salt separates, and the concentrated water is stored in other reservoirs until winter, when it is again allowed to flow back into the shallow reservoirs, where it yields during a cold night thousands of tons of sulphate of soda. The mother liquors from which the sulphate of soda has separated are allowed to flow into Carré's apparatus, where they are subjected to a comparatively intense cold, and yield large quantities of a double chloride of magnesium and potassium, which, on being subjected to heat in a furnace, gives hydrochloric acid, magnesia, and chloride of potassium. This application of Carré's apparatus in this instance shows the simplicity and practicability of it. It is based on rather a different principle to those of Kirk and Harrison. To obtain a low temperature he applies heat to a vessel which contains a saturated solution of ammoniacal gas. This drives off the gas, which is made to pass into a vessel surrounded with cold water, where it liquifies itself by its own pressure. If then the heat be removed from under the solution, its temperature will gradually fall, and it will become again susceptible of re-absorbing the ammoniacal gas, thus facilitating its evaporation from the vessel in which it has condensed; and as it is necessary for the passage of the liquified ammoniacal gas into its gaseous form that it should absorb the heat from the surrounding medium, let it be water or any other fluids, their temperature will gradually decrease. The following diagrams will enable you to understand better the working of this invention:—

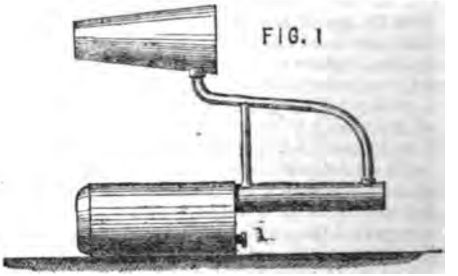

FIG. 1

1. Before each operation incline the apparatus horizontally, and maintain it about ten minutes in the position represented in Fig. 1. 2. Place the boiler (A) in the furnace, and the refrigerator (B) in a bucket filled with cold water, so that the summit of the refrigerator be covered with two or three inches of water. A small quantity of oil is poured into the tube which is placed in the upper part of the boiler, in which also a thermometer is placed. The apparatus is heated moderately until it reaches 266°. The apparatus is then removed from the fire, and the boiler is placed in the bucket of cold water. The hole of the refrigerator being stopped with a cork, and the tin vessel surrounded with alcohol, having previously nearly filled it with water, the congelation takes place by the evaporation of the liquid ammonia in the condenser.

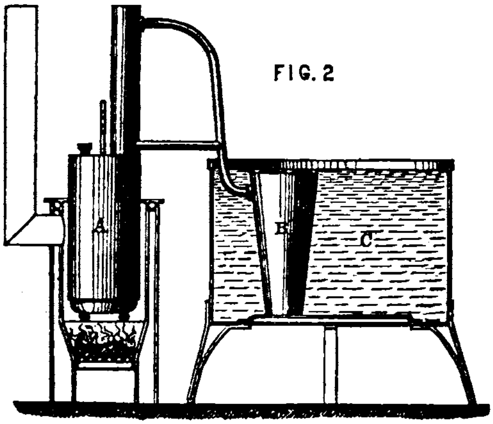
FIG. 2

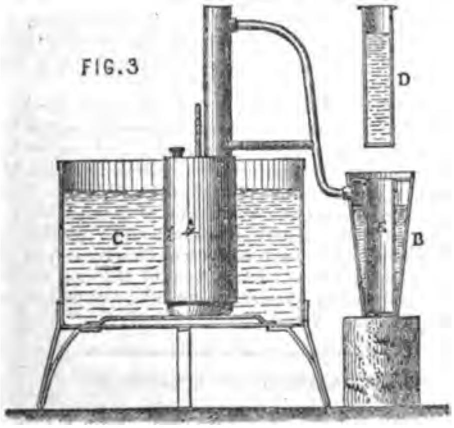
FIG. 3

Although the evening is far spent, I cannot leave you without calling your attention to a very ingenious mode, devised by M. Pelon, for warming railway carriages during cold weather. You are too well acquainted with the present clumsy and expensive method now in use to require any description from me. The only remark I shall make upon it is, that it is the boon of those who are in least need of it—namely, first-class passengers, whilst those of the second and third classes have not that luxury supplied to them. To avoid loss of time, I shall not attempt to describe the various methods which have been proposed as ~~substitutes~~ for the one at present in use, but shall at once state that M. Pelon's method is based on the conversion of force into heat, the heat in this case being generated by friction, and from what I stated in my first lecture you must be perfectly *au courant* of what is understood in the present day of the conversion of heat into force, and *vice versâ*. All those persons who were fortunate enough to visit the French Exhibition in 1855 must have been struck with a machine, invented by Messrs. Mayer and Beaumont, which generated enough heat to convert water into steam, and thus obtain a motive power; and this was effected without fuel or electricity, but by mere frictional heat, which they obtained by causing a wooden mandril surrounded with tow to revolve with great rapidity inside a copper cylinder which itself was surrounded with a small quantity of water. The great merit of the invention of these gentlemen, and which drew upon them the special attention of the Emperor, was that neither the towed mandril nor the copper cylinder were materially injured or deteriorated after many days' working. This important end was attained by them by allowing a gentle flow of oil to run constantly through the cylinder, thus preventing immediate contact between the towed mandril and the copper cylinder. In fact, the frictional heat was produced through the friction which took place between the particles of oil themselves, preventing thereby all wear and tear. Notwithstanding the ingenuity displayed in this invention, still as a means of obtaining motive power it was useless, for more force was required to generate an amount of heat than could be yielded by the friction of the particles of oil. But in the application which M. Pelon has made of this invention to the heating of railway carriages, the motive power required to generate the heat being produced without cost to railway companies, as it is caused by the very act of the travelling of the carriages themselves, the cause which accounted for the failure of the principle as a practical mechanical application—namely, the production of the force required to work it—is overcome. M. Pelon proposes to fix one of Messrs. Mayer and Beaumont's mandrils under each railway carriage compartment, and to convey the heat produced by the revolution of the towed mandril to the compartment itself by means of metallic conducting surfaces, which, in their turn, will heat the atmosphere of the compartment. We shall, I am happy to say, within a year or two, know if M. Pelon's invention will be capable of general adaptation, as it is now being practically tested on one or two of the French railways.

ROYAL SOCIETY.

November 16.

Lieut.-Col. Sabine, *President, in the Chair.*

The following communications were read: 1. "*Synthetical Researches on Ethers: Synthesis of Ethers from Acetic Ethers.*" By Dr. Frankland, F.R.S., and B. F. Duppa, Esq. In this paper the authors describe the action of sodium and the iodides of methyl, ethyl, and amyl upon acetic ether. The complex liquid obtained by the action of sodium and ethyl iodide upon acetic ether is made up of two classes of products: (1) those depending upon the duplication of the atom of acetic ether, and (2) those derived from the replacement of the hydrogen in the methyl of acetic ether by the alcohol radicals. In the first class, two bodies are found,—*ethylic diethacetone carbonate*, $C_{10}H_{18}O_3$, and *ethylic ethacetone carbonate*, $C_8H_{14}O_3$. These are colourless transparent fragrant liquids, insoluble in water, but miscible in all proportions with alcohol and ether. The first-mentioned body, treated with lime or baryta water, or with an alcoholic solution of an alkali, is decomposed, yielding a light ethereal liquid, a carbonate of the base being precipitated. The liquid is *diethylated acetone*, $C_7H_{14}O$. It is a colourless mobile liquid, having a penetrating odour of camphor. Treated in a similar way, the second body yields *ethylated acetone*, $C_5H_{10}O$,—a colourless liquid, possessing a powerful and pleasant odour, in which that of camphor is slightly perceptible. The results of the examination of the second class of products were given in a previous communication, and the authors now only add that *ethacetic acid* is identical with butyric acid, whilst *diethacetic acid* is isomeric with caproic acid.

The reaction of sodium and methylic iodide upon acetic ether gives products completely homologous with those described above. Thus, there are produced two carboketonic ethers,—*ethylic dimethacetone carbonate* and *ethylic methacetone carbonate*—and also an ether derived from the substitution of methyl for hydrogen. By treatment with baryta water, the two former give acetones corresponding to those in the ethylated series.

The authors reserve a complete account of the products of the action of sodium and amyl iodide upon acetic ether for another occasion, and now only mention that by boiling the crude product with alcoholic potash *amylacetic* or *œnanthylic acid* was obtained.

"*Researches on the Hydrocarbons of the Series* $C_nH_{2n}+2$." No. 11, by C. Schorlemmer, Esq. In this paper the author shows that the specific gravity and boiling-point of *methyl-hexyl* (*methyl-caproyl*) nearly coincide with those of *ethyl-amyl*; and although he had only sufficient of the former body to investigate its reactions, he believes that these also would be found to agree with those of ethyl-amyl, and he therefore concludes that the two bodies are identical.

The next paper was "*On Hydride of Heptyl from Azelaic Acid*," by C. Schorlemmer and R. S. Dale. This body is obtained (with others) by heating a mixture of azelaic acid and caustic baryta to a dull red heat. This paper and that above give the results of the authors' examination of compounds having the formula C_7H_{16}, derived from several sources.

The next paper was "*On the Laws of Connexion between the Conditions of a Chemical Change and its Amount*," by A. V. Harcourt and W. Esson, to which we may return when space permits.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, October 31st, 1865.

R. Angus Smith, *Ph.D., F.R.S., &c., President, in the Chair.*

The following communication from Sir J. F. W. Herschel, Bart., M.A., D.C.L., F.R.S., &c., Honorary Member of the Society, was read by Mr. Baxendell:—

"Collingwood, October 18, 1865.

"In the printed proceedings of the ordinary meeting of the Society, on the 3rd inst., I observe a notice of a paper by Mr. Greaves, 'On the Internal Heat of the Earth as a Motive Power,' in which the high temperature of the carboniferous strata, at the depth of 4000 feet (120° Fahr.) is spoken of as likely to oppose an insuperable obstacle to the extraction of coal from that depth. On reading this it occurred to me that by employing condensed air, conveyed through conducting pipes, as a mode of working machinery at that depth—provided the air immediately on its condensation, and before its introduction into the pit, were drained of the heat developed in the act of condensation, by leading it, in pipes exposing a large external surface, through a sufficiently large supply of cold water (or in winter time of snow)—the workings below might be sufficiently reduced in temperature by the re-expansion of the air on its escape, when given out below in the act of working the machinery, to admit of workmen remaining there in comfort; at the same time that ventilation would be supplied.

"If you think that this suggestion would be worthy the notice of the author of the paper referred to, or of those members of the Society who may have been present at its reading, or in any other way available, it is quite at your service for that purpose.

"P.S.—Water at 120° Fahr., or even much higher, would, I fear, afford but an inefficient moving power, unless some means could be devised (without the expense of more power than the gain expected) of concentrating the heat of a large quantity of warm water into a smaller. This might, perhaps, be done through the intervention of air alternately rarefied and condensed."

Mr. Binney, F.R.S., F.G.S., said that at the present time little is known as to the difficulties we should experience in working coal mines at a depth of 4000 feet from the surface. The exact increase of temperature in deep mines is not by any means well ascertained. All we can say is, that no great difficulties have been found in working at a depth of 2100 feet. It must always be borne in mind that the deeper a mine is the greater will be the natural ventilation; that is, the current caused by the air of the mine, at say a temperature of 80° Fahr., ascending the upcast shaft, while the air at the surface, of 40°, descends by the downcast shaft. No doubt a mine might be cooled by the expansion of compressed air, but it could not, so far as at present known, be done economically. In most deep mines a considerable cooling of the air takes place by the expansion of the compressed gas (light carburetted hydrogen) as it escapes from the coal, where it has been long imprisoned under great pressure: and this has not always been allowed for by observers of temperature in such places. In newly-opened mines this pent-up gas forces off large pieces from the face of the coal, and it sometimes makes a noise like water rushing over a weir. In sinking a deep shaft at Wigan some years since the compressed gas in the coal forced up about four yards of strong bind, and made its way through it into the shaft. The rising of the roof of the coal as the shaft approaches it is well known to sinkers in deep and newly-opened coal-fields.

Mr. Edward Hull, F.G.S., exhibited some etchings of caves, fissures, and isolated rocks on the coast of Cantyre, intended to illustrate three classes of phenomena belonging to the raised beach and coast known as "the 30-feet beach," from the fact that its mean elevation is about 30 feet above the present tides. This raised beach has been described by several authors, from Mr. Smith, of Jordan Hill (1836), downwards, and is part of the same beach which has been traced all along the western coast of Scotland, and the vestiges of which remain in a state of remarkable freshness to the present day.

Mr. T. Heelis, F.R.A.S., called attention to the proceedings of a scientific commission recently issued by his Highness the Viceroy of Egypt, who had succeeded in finding a tertiary coal basin in the valleys between Mount Olympus and the Bay of Oraniska, in the Gulf of Salonica, and also on the mainland of Asia Minor, near the Island of Samos; and mentioned some particulars of the coal there found, such as its specific gravity, in which it slightly exceeds the ordinary coal of the coal measures, and the results of experiments upon its combustion, which gives 20 per cent. of ash.

ACADEMY OF SCIENCES.

November 20, 1865.

M. Eug. Peligot presented a memoir entitled "*Chemical and Physiological Studies of Silkworms.*" In the present and in previous communications the author has sought to give the results of an application of the balance to the study of the phenomena manifested in the life and metamorphoses of the silkworm. The extent of his studies is indicated in the following passage:—"A certain quantity of eggs of the worm being given, determine their chemical composition, as well as that of the larvæ produced by the hatching of an equal weight of eggs; feed these larvæ under the usual conditions with mulberry leaves; determine the composition of the leaves given, the leaves left, the worms, and their excrements; make the same researches with the chrysalides and the butterflies; in a word, establish the statical chemistry of a silkworm from its exit from the egg to its death." The reader will see that the author set himself no simple task, notwithstanding that his researches were only directed to ascertain the elementary composition of the various matters. We need not, at all events at present, detain our readers with the various analyses, but give now only the author's conclusions:—1. The development of the larvæ is accomplished by the transport and assimilation of part of the nitrogenised matter of the mulberry leaves. As the chemical composition and anatomical structure are probably the same throughout this stage of the rearing, in the worm just born and in the worm arrived at maturity, the phenomena of nutrition are equally the same during the various phases of the growth of the larvæ. 2. The results of the analyses prove a considerable loss of carbon, which is found as carbonic acid in the air expired by the insect. The amount of carbonic shows that in order to fix 100 parts of carbon from the leaves the worm consumes from 40 to 50 other parts, which is transformed by respiration into carbonic acid. Regnault and Reiset have already remarked that the respiration of the silkworm is more active than that of most of the animals upon which they experimented. 3. There does not appear to be any exhalation or fixation of nitrogen during the development of the silkworm. 4. The analyses prove a loss of hydrogen that seems to correspond to a loss of oxygen, which points to the conclusion that some of the alimentary substance disappears in the form of water.

M. Pouchet continued from last week the account of his "*Experiments on the Congelation of Animals.*" The experiments show that an animal whose body is reduced to the freezing point throughout is killed beyond all chance of revivification. The experiments have a physiological rather than a chemical interest, but some of our readers will no doubt be glad to learn the author's conclusions. These are:—

1. That the first phenomenon produced by cold is a contraction of the capillary vessels to such an extent that a globule of blood cannot enter; these vessels, therefore, remain completely empty.
2. The second phenomenon is an alteration of the blood globules which amounts to their complete disorganisation.
3. Every animal completely frozen is absolutely dead, and no power can reanimate it.
4. When only a part is frozen that part is destroyed by gangrene.
5. If the part frozen is not extensive, and only a few disorganised blood globules pass into the circulation, the animal may recover.
6. But if, on the contrary, the frozen part is of considerable extent, then the mass of altered globules brought into the circulation when the part is thawed, rapidly kills the animal.
7. For this reason a half-frozen animal may live a long time if maintained in the condition, since the altered globules do not get into the circulation; but it expires rapidly as soon as the frozen part is thawed.
8. In all cases of congelation, death is due to the alteration of the blood globules, and not to any effect on the nervous system.
9. It results from these facts that the less rapidly a frozen part is thawed the more slowly the altered globules find their way into the circulation, and the greater are the chances of the recovery of the animal.

M. V. Jodin presented a note "*On the Asphyxia of Leaves.*" The author states that mercurial vapours only effect leaves during the nocturnal respiration, when they absorb oxygen and produce carbonic acid. In the diurnal respiration when they decompose CO_2 and evolve oxygen, the leaf appears to be unaffected by mercury.

M. Persoz submitted another "*Note on Solubility.*" In our last note, said the author, we studied the condensations produced by the solution of salts which fix salinic water, and showed that when, in a chemical reaction, this water is set free, there is always expansion. The author now deals with saturated solutions and the hydration of salts. On the latter subject he formulates the two following propositions:—

Salts, the base of which is an oxide of a metal the highest in a natural group, always crystallise in the anhydrous state. On the contrary, salts of a metal holding a lower place in the same group absorb a certain amount of water.

In double decompositions the author states that he has verified the following law:—

When two saline solutions are in contact, their double decomposition, whether there is precipitation or not, always gives rise to the formation of two new salts having lower volumes than those of salts placed in contact. This law applies equally to the haloid salts.

In the last place, M. Persoz states generally, that when four saline elements find themselves in contact under circumstances (wet or dry) in which double decomposition can take place, it is always the salt which can exist under the conditions of the experiment in the smallest volume that determines the arrangement of the elements.

No illustrations of these laws are given, and we must wait for a more extended publication of the author's views.

NOTICES OF BOOKS.

Inorganic Chemistry for Science Classes. By Fearnside Hudson, F.C.S., F.A.G.L., &c. London: Whitaker and Co. 1865.

We are disposed to look with much favour on this little book. It is the first attempt to introduce the new notation and nomenclature into an elementary work we have seen. We might have said the *newest* nomenclature, for the author gives with all compounds, besides the Gerhardtian name, another name framed on Professor Williamson's principle. We are not prepared to say that this double nomenclature always gives clearness to the descriptions; but, at all events, the way in which it is used is calculated to impress the names strongly on the memory of the student. Thus we read, under Carbonate of Calcium, *Calcic Carbonate*, the following account of the mode of preparation:—

"When a solution of carbonate of sodium, *sodic carbonate*, is added to a solution of chloride of calcium, *calcic chloride*, carbonate of calcium, *calcic carbonate*, is precipitated, and chloride of sodium, *sodic chloride*, remains in solution."

The Appendix, containing various tables and rules for making a variety of calculations often required to be made, is not the least valuable part of the book, which, we may add, is well adapted for use in science classes.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

2370. H. A. Bonneville, Rue du Mont Thabor, Paris, "Improvements in safety lamps for use in mines and other localities." A communication from A. J. Olanier, Rue du Sentier, Paris.—Petition recorded September 16, 1865.

2574. W. Clark, Chancery Lane, "Improvements in apparatus for steeping or treating paper pulp, and other matters subjected to the action of alkalies." A communication from Messrs. Neyret, Orioli, and Fredet, Boulevart St. Martin, Paris.—October 6, 1865.

2842. E. J. Northwood, Felix Place, Islington, Middlesex, "Improvements in plating or combining gold, platinum, and other metals or their alloys."—November 3, 1865.

2882. G. A. Ermen, Eccles, Lancashire, "Improvements in treating vegetable fibres used in the manufacture of paper and other similar substances made from pulp." A communication from L. Horst, Cologne, Prussia.—November 8, 1865.

2894. E. T. Hughes, Chancery Lane, "Improvements in the means of producing from rosaniline blue and violet colouring matters." A communication from P. Mounet, Lyons, France.—November 10, 1865.

2903. W. E. Newton, Chancery Lane, "Improvements in making amalgams or alloys of metals." A communication from H. Wurtz, New York, U.S.A.—Nov. 11, 1865.

2919. W. Fox, M.D., Henrietta Street, Cavendish Square, "Improvements in preserving meat and other articles of food."

2922. W. R. Lake, Southampton Buildings, Chancery

Lane, “An improved method or process for producing paper-makers' pulp from cane, bamboo, and other analogous substances.”—A communication from C. Heaton, New York, U.S.A.—Nov. 13, 1865.

2929. J. Dickson, Abchurch Yard, London, “Improvements in purifying or refining iron.”—Nov. 14, 1865.

2945. W. Clark, Chancery Lane, “Improvements in the manufacture or purification of hydrocarburets, and especially of petroleum oils, used for lighting purposes.”—A communication from Dr. P. G. Barry and the Chevalier B. Degola, Boulevart St. Martin, Paris.—Nov. 15, 1865.

NOTICES TO PROCEED.

1797. J. Peel, Bowling, Bradford, and W. Hargreaves, Little Horton, Bradford, “Improvements in manufacturing grease from soap-suds.”

1807. G. Fentiman, Upper East Smithfield, Middlesex, “Improvements in the preparation of paints.”—July 7, 1865.

1816. H. A. Dufrené, Rue de la Fidelité, “An improved self-acting apparatus for obtaining a circulation of volatile liquids.”—A communication from F. Massot and A. Juquin, Rue Rivoli, Paris.—July 8, 1865.

2293. F. Tolhausen, Boulevart Magenta, Paris, “A new fire firework, producing instantaneously the forms of serpents and other forms of a like nature.”—A communication from F. Barnet and C. A. Rouseille, Rue de Rivoli, Paris.—Sept. 7, 1865.

2350. T. Bell and T. L. G. Bell, Plaistow, Essex, “Improvements in apparatus used for calcining and roasting copper and other ores, and substances containing sulphur.”—Sept. 14, 1865.

2436. T. V. Lee, Macclesfield, Cheshire, “Improvements in preparing peat or turf for firelights and fuel, and for machinery to be employed therein.”—Sept. 23, 1865.

1841. H. Blair, Kearsley, Lancashire, “Improvements in the production of gases from aqueous vapour, and in the application thereof to heating purposes.”—Petition recorded July 12, 1865.

1855. A. E. Molin, Fahlen, Sweden, “Improvements in separating gold from ores containing copper and gold.”—July 14, 1865.

1939. E. Spicer, New Bridge Street, Blackfriars, London, “Improvements in compositions similar to gunpowder, for blasting, for use in ordnance and fire-arms, and for other purposes.”—A communication from P. Nisser, Melbourne, Australia.—July 26, 1865.

1980. A. V. Newton, Chancery Lane, “An improvement in refining petroleum and other hydrocarbon oils.”—A communication from R. A. Cheeseborough, New Rochelle, New York, U.S.A.—July 13, 1865.

2677. A. H. Hassall, M.D., Wimpole Street, Middlesex, “Improvements in the preparation of meat for food.”—Oct. 17, 1865.

2803. R. Cassells, Glasgow, N.B., and T. Morton, Motherwell Iron Works, in the county of Lanark, N.B., “Improvements in furnaces.”—Oct. 31, 1865.

2872. G. A. Jasper, Middlesex, Mass., U.S.A., “Having reference to the cleansing or bleaching of sugar, which invention may also be applicable to other purposes of like character.”—Nov. 7, 1865.

CORRESPONDENCE.

Pills of Extract of Cod-Liver.

To the Editor of the CHEMICAL NEWS.

SIR,—Having observed your question in last week's journal with regard to the pills you have seen in our window, we beg to say that Guffroy's Dragées of Cod Liver Extract sold by us are not “cod-liver oil pills,” but are composed of a concentration of the watery exudations which exist in the livers along with the oil, and which are held to be equal, if not superior, to the oil in the chemical constituents to which that substance owes its medicinal value. You will find the process for the preparation of the extract in our two patents dated respectively July 10, 1860, and July 29, 1861.

We write this as we have suffered much annoyance through our preparation being called “Cod-Liver *Oil* Pills,” with which medicine we have no connexion.

We may also mention that our extract is exempt from the medicine stamp duty, as it is not a secret nostrum, but simply a modification in the “preparing medicinal substances and compounds from the livers of cod,” and it is, therefore, not sold under stamp.

Trusting you will give our explanation publicity, so as to disabuse the minds of your readers of the fact that we sell “a quack medicine,” We are, &c.

BARR AND CO.

83, Fleet Street, London, November 28.

P.S.—We enclose a series of samples of our article in its various stages of manufacture, for your satisfaction.

[We have received a specimen of the extract, also of the pill mass, which is composed of six parts of extract, five of cacao butter, and one of sugar, and also some of the pills. An analysis of the extract by Professor Garreau gives its composition as follows:—

“Ichthyoglycine	50·000
Propylamine	2·545
Acetic, lactic, and butyric acids	6·000
Phosphoric acid	2·090
Sulphuric acid	0·200
Chlorine	1·525
Iodine	0·154
Bromine	trace.
Soda	1·170
Potash	0·211
Magnesia	0·366
Lime	0·510
Ammonia	2·862
Extractive matter undetermined, gadin, &c.	10·620
Water and loss	21·847
	100·000

“It will be observed on referring to this analysis, that two somewhat novel organic substances—namely, propylamine and ichthyoglycine, occupy prominent places in the table. The former, as well as several of the inorganic constituents, exists in cod-liver oil, but in such minute quantities as generally to escape detection. It has, nevertheless, been more than suspected by Winkler and other German chemists, that the remedial properties of cod-liver oil are to be attributed to the existence in that body of the conditions necessary for the formation of propylamine.” (See *Pharmaceutical Journal* for 1851, vol. xii., p. 450.)

We need only add that the pills are unquestionably a genuine preparation of the extract, and not an imposture, like the “cod-liver-oil powder” examined by Dr. Attfield.—ED. C. N.]

The Utilisation of Soda Waste and Chlorine Residues.

To the Editor of the CHEMICAL NEWS.

SIR,—It has been very gratifying to me to see in Mr. Walker's highly interesting letter the corroboration of some of my remarks; and I regret sincerely to have had no occasion of perusing their specification, which would have prevented me making unwittingly erroneous objections against a process never proposed by Messrs. Walker and Townsend.

May I now be permitted to correct some ideas of Mr. Walker about the stumbling-block he has discovered in my own propositions? If in my process (or more precisely in my proposed arrangement of processes, nearly all more or less known and practised) pure MnS was produced, the objection would have been perfectly right. Yet this is not the case.

After dechloration of the chlorine residue, after neutralisation with evolution of sulphuretted hydrogen, which must be burnt, either for sulphurous acid or for sulphur, if we have not the utilisation of SO^2 immediately at hand there remains in solution neutral chloride of manganese. When the neutralisation has been completely accomplished, no iron is found in solution, the soluble salts of iron being precipitated much more easily by soda waste, in the state of FeS, than the manganese salts. The chloride of manganese is now decomposed, not by soda waste itself, but by the liquid which drains from the heap of soda waste, and which is collected purposely for this precipitation. This makes a very great difference.

The liquid drainings from accumulated soda waste, especially when the latter has been properly disposed, consists principally of a weak solution of persulphuret of calcium. It produces with Cl_2Mn, not MnS, but sulphuretted sulphuret of manganese. Experiment has shown that the yellowish precipitate, when dry, contains from 44—90 per cent. sulphur, of which quantity approximately 28—39 per cent. can be extracted by sulphide of carbon, and, therefore, exists in the precipitate in the state of free sulphur. 2800 gallons of chlorine residue treated in this manner produce nearly two tons of sulphuretted sulphuret of manganese (containing nearly one ton of sulphur), which are easily washed, dried, and burnt, evolving then from 14 to 16 cwt. of utilisable sulphur in the state of sulphurous acid.

I shall give with great pleasure the figures resulting from trials made upon a very large scale to any manufacturer who should be interested in this question, and wishes to try the process, for which no patent has been taken out in England. For the production of an abundant and well-composed solution of persulphuret of calcium, I should recommend the following manner of building up a heap of soda waste (or mountain? *l'amas de charrée*), in order that it may, without any extraordinary expense, be aërated in all parts, and undergo quickly the desirable oxidising reactions. The plan is founded on the principle, admitted, I believe, by all manufacturers, that soda waste is *not* susceptible, without evident pecuniary loss, to any manipulation requiring hard labour or costly mechanical arrangements.

In every chemical work there is produced, in exact proportion to soda waste, a quantity of coal slag, from the sulphate and black ash furnaces, the steam-boilers, and the evaporating pans. The same furnaces produce, unhappily, much too quickly for the manufacturer, a certain quantity of broken and rotten bricks (*briques usées*). These bricks and coal slags are deposited upon the heap of soda waste in rows about one yard high and broad, and at a distance one from the other of four to five yards. Soda waste is thrown between these rows, and after a layer of a certain thickness has been deposited—say of two or three yards—new rows of coal slag are established in alternative order with the first, &c., &c. The coal slag and the bricks represent the channels through which atmospheric air can penetrate in the interior of the soda waste and oxidise the Ca_2S_3 to CaS_2 and CaO. The heap of soda waste becomes in this manner a real apparatus of an enormous size, in which sulphur is quickly rendered soluble and concentrated in the rain water filtering through the heap.

All round the heap there are dug open gutters, to collect the drainings and conduct the solution of polysulphuret of calcium to very large (reservoirs) tanks. If there should be not enough rain to produce a sufficient quantity of drain liquid, water pipes must be established at the top of the soda waste heap, and a regular lixivation organised.

In a comparatively short time soda waste treated in this manner loses a considerable quantity of sulphur, and the remainder of the waste is so thoroughly oxidised that it can be used as a tolerable manure, and in every case constitutes a nuisance no longer.

It seems evident to me that Messrs. Walker and Townsend and I have been working, independently one of each other, in the same direction. I should be glad to have Mr. Walker's opinion about a paper, dated July 10, 1855, which he will find recorded in a "Repertory of Patent Inventions," vol. xxvii., 1856, p. 406, treating on hyposulphite of alumina.

It is possible that as regards several ideas I may have the benefit of age; in many other respects not a very enviable one. I am, &c. E. Kopp.

Saverne, Bas-Rhin, Nov. 20.

The Past and Present History of Alum.

To the Editor of the Chemical News.

Sir,—I must leave your readers to judge whether my remarks upon Dr. Muspratt's Dictionary are correct or not; according to his account, his work is "second to none." Dr. Muspratt forgets when he says that this is the first and only time that the information in the Dictionary has been called into question, for when the article first appeared, Mr. Spence himself wrote to Dr. Muspratt informing him of the false statement; but the Doctor did not even deign to answer the letter, but left it to one of his assistants or clerks, who wrote, that it could not be expected that Dr. Muspratt could be well up in all the minutiæ of manufacturing chemistry; and concluded, that if Mr. Spence would like a better description, it should be given another time.

Dr. Muspratt puts forth the excuse that the paper on "Alum" was written nearly fourteen years since, making out that it was not possible to have known of Spence's patent then. Mr. Spence took his patent out in the year 1845, which is exactly twenty years ago. Therefore, I contend that whoever wrote the paper and mentioned Spence's patent, ought certainly to have read it, and given a proper description of the process, for the works were then in full operation at Pendleton.

In the Chemical News of September 21, 1861, it is said that in 1850-51 Mr. Spence made about twenty tons per week. The writer of Muspratt's article was certainly some years behind his time, for Dr. Muspratt says each paper as it came out contained the latest improvement; he might have added, *except in the case of alum.*

I can only repeat my former assertion, that it was a most unfair description of such an important improvement. I think "the great chemical work of the age" ought to keep pace with the great chemical improvements, and not be lagging a quarter of a century behind; but we must not forget to bear in mind that the brighter the diamond the darker appears the speck; and no wonder such an error looks greater in a work that has been "eulogised by the first *savans* of the world." The book, indeed, must be great to have only one error. But, "let another man praise thee, and not thine own mouth." Why I found fault with the article is certainly best known to myself, but which I can easily make known to others. It was simply to show that Mr. Spence's was not a pirated process, as one might have come to that conclusion on reading the article.

I am afraid Dr. Muspratt's information on alum has not advanced further than it did twenty years ago, for he concludes his letter—"If I should re-write 'Alum,' a better description will be given, if *requisite.*" It may be news to Dr. Muspratt to say that more than two-thirds of the alum made in this country is by Spence's process, and I think your readers will come to the conclusion that a better description of alum is certainly requisite.

I am, &c.
J. Carter Bell, F.C.S.,
Associate of the Royal School of Mines.

"*Associate of the Royal School of Mines.*"

To the Editor of the Chemical News.

Sir,—The title quoted above must have caught the eye of all diligent readers of your own and other scientific journals, raising, as in my own case, a somewhat languid curiosity as to the precise value and meaning to be attached to this resounding affix to the names of some few writers on scientific subjects.

Judging from a "History of Alum," by an "Associate," recently published in the Chemical News, correctness in English composition is clearly not rigidly exacted as a qualification for this honour; but it is to be hoped that the Conferrers of this title insist upon accuracy in matters of science, if they fail to require it in matters pertaining merely to purity of style.

Degrees and diplomas bestowed by the Universities and Chartered Corporations empowered to grant these honours deserve respect; but what does this "*Associate of the Royal School of Mines*" signify, and by what authority is this title conferred? The Royal School of Mines, as a national institution, either is authorised to grant degrees and dignities to qualified persons, or the governing body must have exceeded its powers and taken upon itself to give what it has no right to bestow. Will the Registrar of the Royal School of Mines state for general information by what authority this degree of "*Associate*" is granted?

I am, &c. J. Denham Smith.

The Chemical Society's Specimens.

To the Editor of the Chemical News.

Sir,—There is one interest attaching to the specimens which the Council are about to distribute, which was not alluded to at the meeting, but which, I think, ought not to be overlooked in estimating their value, and deciding on the disposal of them. It is that they are all what I may call authentic historic specimens. I must confess that I have never been at the pains to inspect the contents of the case, but I have no doubt there will be found in it some things the discovery of which marks an era in the development of chemistry. Every attendant at the Royal Institution will remember the value attached to the small specimen of benzole first isolated by Faraday, and which is always produced when aniline and its compounds form the subject of illustration. There may be nothing of equal value to that in the Society's case, but there may be many things which, at some future time, may be looked at with great curiosity; and when the specimens are not returned to the donors, care should be taken to commit them to the custody of some institution in which their value may be duly estimated. The Jermyn Street people will, probably, look with contempt on the collection,—as so many dirty bottles; but perhaps the College of Chemistry may some day be lodged in a building in which space could be found for the display of specimens, which all chemists must look on with much interest. I am, &c. F.C.S.

Nov. 19, 1865.

MISCELLANEOUS.

Gun Cotton in the American Mines.—The application of Messrs. Prentice's (Stowmarket) gun cotton is becoming very general in the mines of California and Nevada, the greatest satisfaction being expressed with regard to it in every instance in which it has been employed. At the New Almaden Quicksilver Mines it has been largely used, and Mr. C. E. Hawley, the chief engineer, reports that the gangue rock of the Almaden vein is very hard magnesian limestone, in many place worth $30 per foot—lineal—to work in ordinary drifts of 6 ft. by 5 ft. In other parts of the mine the rock is partially decomposed and easy to work. To his surprise, the miners in soft rock were more desirous than any others of using gun cotton. He considers that the most valuable quality it possesses for their use is its freedom from smoke. This vein is extremely irregular, and its workings of great extent. Good ventilation cannot be maintained everywhere, and smoke of the richest "labores" in the mines are now seriously delayed by the smoke of blasting powder. The perfect freedom from smoke of the gun cotton would warrant the using a limited quantity at considerably greater cost than powder. In Nevada city district and Calveras the opinions expressed are equally favourable, and we may predict that in the Pacific States the use of gun cotton for mining purposes will eventually be universal.—*American Gaslight Journal.*

Apropos to a Thermo-Electric Battery.—Not unnaturally, this thermo-electric battery is exciting the imaginations of men of science, causing them to call up wonderful visions of a future when much of the work of the world shall be done by sunshine. Thus a contemporary suggests that, "like windmills, thermo-electric batteries might be erected all over the country, finally converting into mechanical force, and thus into money, gleams of sunshine, which would be to them as wind to the sails of a mill. What stores of fabulous wealth are, as far as our earth is concerned, constantly wasted by the non-retention of the solar rays poured on the Desert of Sahara. Nature here refuses to use her wonderful radiation-net, for we cannot cover the desert sands with trees, and man is left alone to try his skill in retaining solar energy. Hitherto helpless, we need not be so much longer, and the force of a Sahara sun may be carried through wires to Cairo, and thence irrigate the desert, or, possibly, if need be, it could pulsate under our streets, and be made to burn in Greenland." A fascinating dream enough, and one which may prove to be "not all a dream."—*Scientific American.*

Essence of Apples.—By essence of apples is meant an alcoholic solution of valerianate of oxide of amyle. This product is sometimes simply prepared by distilling crude potato oil in presence of sulphuric acid and bichromate of potash; but in this way a mixture is obtained of very little essence of apples and very much amylic alcohol. It is better first to prepare the valerianic acid by the following method:—Mix gradually one part of potato oil with three parts of sulphuric acid and two of water; mix separately two parts and a-half of bichromate of potash and four parts and a-half of water; then mix the two liquids so as to keep up the boiling in the retort, saturate the distilled liquid by carbonate of soda, and crystallise the valerianate of soda. Then take one part by weight of potato oil, and carefully mix it with an equal weight of sulphuric acid, add one part and a-half of well dried valerianate of soda, and keep it gently heated in a water bath. The addition of water causes the ether to separate, when it may be purified as above. This valero-amylic ether mixed with five or six times its volume of alcohol constitutes the pleasantly scented essence of apples. —*Des Odeurs, des Parfums, et des Cosmetiques, by S. Piesse.*

Chemical Society.—The next meeting of this Society will take place on Thursday evening next, at 8 o'clock, when a paper, by Dr. Gladstone, will be read "On Pyrophosphotriamic Acid."

ANSWERS TO CORRESPONDENTS.

M. D.—Received.

Ge. L.—Use oxide of gold as the colouring agent.

Dr. F. J. Bond.—See the book reviewed this week. The last edition of Miller gives the new formulæ.

Formula.—German yeast is mostly obtained from the distilleries at Hamburgh and Rotterdam. We have seen a formula which directs the fermentation of a decoction of rye meal and honey, but cannot put our hands upon it at this moment.

Books Received.—"The Fairy Tales of Science," by John C. Brough.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Physiological Exhaustion and the Vitality of Beer Yeast, by M. A. Bechamp.*

The life of the leaven being contained in the cellule, I supposed that, so long as this cellule was neither destroyed nor dead, the leaven would continue to live, and to manifest this life by its characteristic chemical actions, but in certain cases, such as those about to be described, like an animal in a state of inanition—that is to say, in exhausting itself.

To measure the physiological exhaustion of beer yeast, I estimated the phosphoric acid it eliminates while consuming its own tissues, when forced to live in distilled water.

Mitscherlich analysed beer yeast, and from his analysis concluded that 100 grammes of dry yeast contain the elements of 4·28 gr. of anhydrous phosphoric acid. But this analysis does not prove that the acid was actually formed there.

The infusion of yeast is, no doubt, always acid, and this acidity may be attributed to phosphoric acid, if the yeast does not ceaselessly engender other acids. To ascertain that the yeast actually contained preformed phosphoric acid, and phosphates, boil the well-washed yeast in a large quantity of distilled water; this will kill it, and cause it to abandon various products, and among them phosphoric acid, which estimate by the process presently to be described, whence it will be found that 100 grammes of dry yeast disengages from 2·8 gr. to 3·1 gr. of phosphoric acid, of which a portion is free.

But though the yeast abandons large quantities of phosphoric acid, at a temperature of 100°, when it is killed, this is not the case when it is left in water, either cold or even heated to 30 or 40°; under these circumstances it abandons the phosphoric acid and other matters very gradually, not as an inert precipitate, but as a living creature, offering vital resistance to destruction. By renewing the water every twenty-four hours, and estimating the phosphoric acid in each lixivium, it will be found that the quantity of this acid, small at first, augments with each successive treatment, and rapidly attains a maximum, after which it decreases, until it altogether disappears. The following is the experiment:

In the first place I determined the amount of phosphoric acid which could be found in matters adhering to the yeast, proceeding from the medium in which the yeast was formed, or which had been excreted by the yeast itself and impregnated it externally. 500 grammes of brewers' yeast, new and in a paste, were soaked in cold water and washed on a filter. The yeast having been well drained, there remained four litres of lixivium. In this liquid the phosphoric acid was estimated by the same process which was applied to the following estimations; and there were obtained of anhydrous phosphoric acid, 0·095. gr.

This result is invariable; all things being equal, 500 grammes of yeast in a paste, representing about 100 grammes of dry yeast, yield to cold water less than 1 decigramme of phosphoric acid.

280 grammes of this same washed yeast, containing 48·2 gr. of yeast dried at 100°, were introduced into a special apparatus with 1600 cubic centimetres of water boiled and then cooled to 40° in a current of carbonic acid. To make perfectly sure that no foreign bodies were formed, a few drops of creosote were added to the water intended for washing. Every twenty-four hours the water was decanted and renewed by a fresh supply, under the same conditions. All these washings were screened from the air in an atmosphere of carbonic acid, the apparatus being in a warm place, the temperature of which could vary from 20 to 30°.

These washings furnished the following results:—

	gr.
1st washing—anhydrous phosphoric acid. .	0·056
2nd ,, ,, ,, . .	0·073
3rd ,, ,, ,, . .	0·074
4th ,, ,, ,, . .	0·076
5th ,, ,, ,, . .	0·346
6th ,, ,, ,, . .	0·444
7th ,, ,, ,, . .	0·371
8th ,, ,, ,, . .	0·190
Total of phosphoric acid .	1·630

These numbers appear significant. Were beer yeast merely an inert precipitate, were phosphoric acid present in the mass, as mother liquor is in a precipitate, the washings would eliminate the greater part of the soluble matters in the first operations, and the quantity of these matters would diminish more and more. But we see here that the yeast at first resists, then suddenly its resistance diminishes, and it yields a large quantity of its disassimilated materials. This is ascertained by the weight of the phosphoric acid eliminated, which suddenly increases to five or six times its previous weight; after which it naturally decreases.

By adding the amount of the different estimations at 100° of the phosphoric acid in dry yeast, the number will be found to be 3·38. The weight of phosphoric acid eliminated is then greater by ¼ than that produced by the incineration of the yeast, as in Mitscherlich's process; and if it is observed that the yeast eliminates at the same time various other products, proportionately to the quantity of phosphoric acid, an idea may be formed of the degree of exhaustion undergone by each globule. The exhaustion is such that under the microscope the yeast seems reduced to merely its envelope; it is then barely visible, and its colour so faint that it looks like shrivelled skins, with no clear outlines, and with a taste like raspberries. From the nuclei or interior granulations which remain, the form of the envelope may be divined.

If by the use of the apparatus, elsewhere to be described, the air is perfectly excluded, this exhaustion can be effected, without what is called the putrefaction of the yeast, or, more correctly, without the appearance of the organisms which cause the putrefaction of the organic matters eliminated. But if air enters, these products acquire a fœtid odour, and there may be observed a disengagement of sulphuretted hydrogen, and the formation of the infusoria, which are the cause of a particular fermentation of the nitrogenised and sulphuretted organic matters of yeast. However, if the other products accompanying phosphoric acid are different, the quantity of the latter in each washing corresponds to the numbers of the above table.

The yeast exhausted in the experiment which furnished the numbers given in the table appeared to be dead; but this was not the case, for it was still capable of transforming cane sugar into glucose—that is to say, of forming zymase and then producing alcohol by the glucose engendered. But the products of alcoholic fermentation by exhausted yeast are notably different in nature and in quantity from those obtained by normal

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* *Comptes Rendus*, lxi., 689.

yeast. The same as in alcoholic fermentation by mother of vinegar, a crystallisable compound is formed possessing the properties of mannite.

These results prove contrary to Mitscherlich (who supposed that the globules of ferment, well washed in water are entirely deprived of the property of saccharifying cane sugar), that yeast continues to change cane sugar until it ceases to live, and that when it is so much exhausted that it may be said to be reduced to its cellule, it nevertheless continues to form successively glucose and alcohol with cane sugar. The property of determining alcoholic fermentation must not, then, be attributed to the catalytic action of some chemical compound which it contains; my researches seem to prove that it is contained in the properties of the living cellule; it is a consequence of the act of nutrition of this cellule.†

Detection of Methylic Alcohol, by Mr. JOHN T. MILLER.

THE following modification of my process for the detection of methylic alcohol may be used when it is wished to avoid distillation. It is easy of execution, and gives very fair results:—

Prepare in a small flask an oxidising solution with 20 grains of bichromate of potash, 3 fluid drachms of water, and 20 minims of strong sulphuric acid, and add to it 30 minims of the spirit to be tested. After the mixture has stood ten minutes, add just enough milk of lime to give it an alkaline reaction; warm, filter, and wash with half an ounce of warm water. The filtrate will be free from chromic oxide and the greater part of the sulphuric acid. Precipitate the remainder of the latter, and any chromic acid which may be present, by the addition in small excess of a strong solution of acetate of lead; warm slightly, allow a few moments for the precipitate to subside, and filter. The filtrate should now be clear, colourless, and nearly neutral to test-paper. Boil it quickly down to 2 fluid drachms, pour it into an ounce test-tube, add 1 drop of dilute acetic acid (1 part of the B. P. acid to 2 parts water), and 1 grain of nitrate of silver in 30 minims of water; then heat the liquor slowly to the boiling-point, and simmer two or three minutes. Darkening of the solution to a considerable degree may occur even though the spirit be free from methylic alcohol, and is, therefore, a less reliable indication of the presence of that substance than when the oxidation products have been separated by distillation. The state of the test-tube will, however, decide the question. It should be rinsed out, filled with water, and placed against white paper. If it appear clean and uncoloured, the spirit is either pure or contains less than 2 per cent. of methylic alcohol; if, on the other hand, the lower part of the tube have an evident brown tint, the spirit is methylated.

To obtain satisfactory results by this process, the points to be minded are:— 1. To use distilled water. 2. To add only a slight excess of the precipitants. 3. To use a perfectly clean test-tube. 4. To avoid boiling the liquor up the tube, and so thinning the metallic deposit by spreading it over a larger surface.

I have tried various oxidising agents, but have found none better or more manageable than bichromate of potash.—*Pharmaceutical Journal.*

PHYSICAL SCIENCE.

An Account of the Water-Barometer Constructed and Erected by ALFRED BIRD, *Experimental Chemist, Birmingham.*

I HAVE the pleasure to send for insertion in the CHEMICAL NEWS an account of a water-barometer, which I have had in perfect action for six years. It was shown to the members of the British Association on their visit to Birmingham, and a general desire having been expressed that an account of the instrument should be published, I send you the following particulars and drawings:—

In the construction of a water-barometer four things have to be attended to,—

1st. The water must be deprived of air.

2nd. The air must not again enter the water.

3rd. The water must go into the barometer, to the exclusion of the air; and

4th. The instrument must be so constructed that, while the atmospheric pressure within the instrument shall be uninterrupted, no air shall penetrate into the vacuum-chamber.

I will begin by describing the material. The tube is composed of metal and glass, and the three taps are those known as "Lambert taps." The size of the metal part is half an inch internal diameter, and is that sort of white-metal tube which is in universal use by gas-fitters, called "compo." I believe it is an alloy of lead and zinc.

I recommend the compo tube made by Messrs. Stock, Brothers, and Co., in Birmingham, as it will stand an internal pressure of fifty pounds of air to the inch without leaking. The glass tube to show the "readings" is one inch internal diameter and six feet long. The brass Lambert taps are half an inch internal diameter. These taps are constructed internally with a cushion of india-rubber, pressed down by means of a brass plate acted upon by a screw, which makes them absolutely secure.

I will next describe the upper and lower parts of the barometer in reference to the drawings. Plate 4. AA is the compo tube, having two enlarged sockets B, B, one and a-half inch in diameter and three inches deep. These sockets were made of brass, and their office is to receive the ends of the glass tube. To fix the glass tube C, about six inches of the compo tube was soldered to the bottom of the socket, and being inverted and fixed very steady, enough dry sand was poured into the compo tube to fill it up to the bottom of the socket B. The use of the sand is to prevent the cement from running into and stopping up the compo tube. The glass tube C, perfectly clean inside, was now placed in the socket; and being most carefully steadied to keep it upright, six inches of dry sand were poured down to keep the cement from rising up the glass tube C.

The cement was composed of two parts of gutta percha and one part of common black pitch. These two substances were heated in an iron ladle with a lip, till they became perfectly fluid and quite free from froth. A "copper bit" used by plumbers having been heated to low soldering-heat, a small quantity of the cement was poured into the socket. The copper bit was then applied to the outside, the effect being to perfectly liquefy the cement *in situ*. A little more of the hot cement was

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† These conclusions are opposed to M. Liebig's assertion (*Traite de Chimie Organique*, introduction p. 27):—"The insoluble body called 'ferment' does not provoke fermentation." The proof he gives of this is, that the yeast washed with water, deprived of air, leaves a residue which has lost the power of fermenting cane sugar. This has caused it erroneously to be supposed that the phenomenon being much less decided had ceased to exist at all. On the other hand, much less attention is given to the previous inversion of the cane sugar, and it is well known (notwithstanding an important and probably unknown experiment of M. Dubrunfaut) that M. Pasteur has admitted that cane sugar ferments directly, the formation of changed cane sugar being consecutive to the formation of succinic acid.

then poured in, and again the heated copper bit was applied till the socket was quite full of very fluid cement without any air cavities. As the cement cooled, it clung to the glass and metal, and became absolutely solid and air-tight. If the cement is poured in all at once, it is impossible to prevent crevices, which will let in air when the barometer is filled, causing the water gradually to descend till it falls out of the instrument.

A place being chosen on the staircase of my house, a flat board seven feet long and one foot wide, was fastened to the wall, upon which board was fixed the socketed glass tube C, and graduated scale F, from the top of which 422 inches were most carefully measured down to the "zero"-point E beside the cistern.

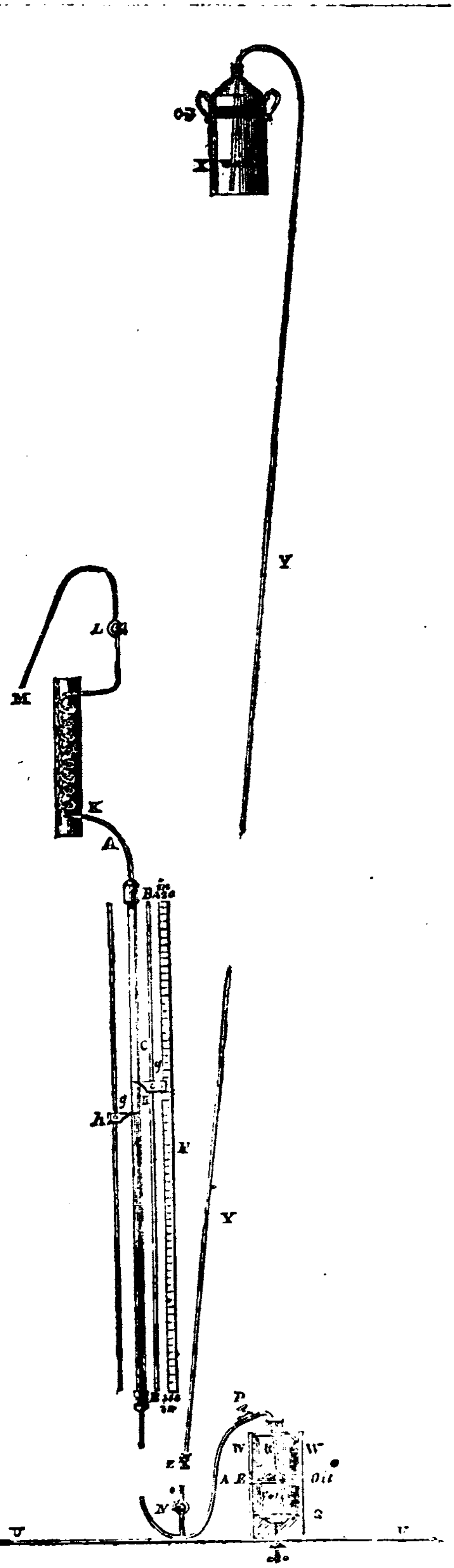
The scale F is to the right of the glass tube. It is made of well-seasoned boxwood, and is graduated to inches and tenths. The sliding-tube G, with the vernier H, is between the glass tube and the boxwood scale F. On the left side of the glass tube C is another sliding-tube *g*, with a vernier *h*, to record position of top of tidal column of water at 9 a.m. the morning previously.

The glass tube, scale, and verniers having been securely placed on the board and perfectly upright, the gas-fitter proceeded to connect, by soldering, the remainder of the compo tube above the glass tube C, which was continued upwards till it entered nearly at the bottom into a round vessel K, made of zinc, four inches in diameter and eighteen inches high. Inside the vessel the tube coils round in a spiral, like the worm of a still. This vessel and spiral are not necessary to the action of the barometer; but as the spiral is in the part of the tube in which is the vacuum-chamber, it gives the opportunity of artificially cooling with ice or snow the included aqueous vapour, and thus determining by actual experiment the amount of correction required.

If the experiment of cooling the included vapour to 32° be tried in summer, when the external temperature is 70° or 80°, the sudden cooling causes so great an evaporation from the surace of the water, and condensation in the upper part of the barometer, that a real rain-shower is produced, the condensed water running down the glass tube in innumerable pellucid drops in the most beautiful manner, thus perfectly imitating the condensation of invisible watery vapour in the higher regions of the atmosphere. When the compo tube leaves the zinc vessel, it is led up perpendicularly to the Lambert tap L. Above the tap L the tbe still rises perpendicularly, when it suddenly bends down, leaving the end open at M.

I now describe the part of the barometer below the glass tube.

The compo tube being soldered on, was carried down to the cistern, not necessarily perpendicularly; for instance, the tube may descend at an angle of 30° or 40°, and may be led in any convenient direction. The entire instrument erected by me is inside the house, to escape a freezing temperature. At the lowest bend of the compo tube is a short upright tube, having at the end a Lambert tap N, to which is soldered a male screw of a ⅜th-inch gas union-joint O, the use of which will be understood further on. The compo tube now begins to ascend; and at the top of the bend is another Lambert tap P. Beyond this the compo tube bends down and reaches nearly to the bottom of the cistern, which is a one-gallon white glass narrow-mouth upright bottle R. The bottle rests upon a stand S, which moves up and down by means of a set screw T, acting through a stout shelf U U; and the bottle is kept steady by means of the two



uprights W, W, upon one of which is fixed the zero-point E.

I shall now describe the method of filling the barometer. Four gallons of water were carefully distilled, and being put into a perfectly clean and new tin oil-can with a narrow mouth, the water was boiled for one hour over a bright fire, to drive out the air. While still boiling, two quarts of olive oil were poured in. This slightly increased the pressure in the water underneath, causing the last remains of the air to rise with the steam in jets or spirts through the stratum of oil. The instant ebullition was stopped, the oil closed over the boiled water, and it became hermetically sealed from the atmosphere. The contents of the tin can were now cooled, and the can X was placed above the top of the water barometer. A piece of $\frac{3}{8}$th-inch gutta-percha tube Y Y, sufficiently long to reach from the can X above to below the very bottom of the barometer, was procured, and one end of the tube was put into the mouth of the can X, the end passing through the supernatant stratum of oil down to the bottom of the water underneath. At the other end of the gutta-percha pipe Y is a $\frac{3}{8}$th-inch tap, terminating with a $\frac{3}{8}$th-inch female screw union-joint Z. The gutta-percha pipe being in position, and hanging down as seen in the drawing, became a syphon; and the air being sucked out, the water at once came over, and was stopped from running away by turning the small tap Z. The female union-screw at Z being tightly screwed on to the male screw-joint O, the water was ready to enter the barometer.

The first thing to be done was to displace the air in the bend of the tube, reaching from the tap N at the bottom to the extreme end of the compo tube in the cistern R. This was done in the following manner:—The cistern or bottle was taken away and filled quite full to the very brim with best olive oil; the three Lambert taps being all open, and the bottom end of the "compo" tube hanging down, the small gas-tap Z was opened; the water then began to ascend both legs of the barometer, and when it reached the tap P, it passed over and ran out of the end of the tube which was hanging down. At that instant the stream was stopped with the thumb, and, the tap Z being turned off, the bottle full of oil was brought to the thumb which stopped the end of the compo tube and kept in the water. The thumb supporting the tube was now put into the oil, and the end of the tube slipped down to the bottom of the oil. The bottle was then put into its place on the stand S, and the surplus oil being syphoned out, there remained in the cistern R about three inches in depth of olive oil, the compo pipe dipping into it nearly to the bottom.

The next thing was to fill the longer part of the barometer, which was accomplished as follows:—The tap P being closed and the small tap Z opened, the water rapidly rose in the barometer; when the water had reached the opening M at the top, it was allowed to run a minute or two to carry any traces of air away which might have lingered in the tube. Tap L at the top, and tap N at the bottom being then securely closed, tap P was opened, and the column of water began to descend and to accumulate in the cistern R under the stratum of olive oil. As the column fell it was narrowly watched in the glass tube, but not a bubble of gaseous matter was observed. On examining the cistern R, it was found that the oil did not quite reach the zero-point E, more oil therefore was poured in till the zero-point E and the level of the oil were coincident. The graduated scale was now looked at, and it showed that the column of water was 400 inches high, the mercurial barometer being 30·4 inches, and the temperature 67°.

In order to see whether gaseous matter would accumulate in the vacuum chamber, the gutta percha syphon was allowed to remain in its place for some weeks, and four different times tap P was closed, tap N opened, with tap Z, thus filling the barometer up to tap L at top, which being opened allowed the water and gaseous matter, if there had been any, to flow out at M. On closing tap L and tap N and opening tap P, the column of water again fell; and after syphoning out the surplus water from under the oil in the cistern till the oil was level with the zero-point E, the column of water was found on the four different trials to be exactly the same height on the scale after each trial as before. It was, therefore, plain that no gaseous matter had accumulated above the water, and that, with the exception of the vapour of water, it was a perfect vacuum.

One or two precautions are required in order to ensure success. In the first place, the water must be distilled—for if the water contains "earthy salines" or colouring matter, it is certain, by the constant evaporation and precipitation in the working part of the glass tube, to crust it over so completely, that in a few months the water becomes invisible; pure distilled water is, therefore, indispensable. Then, if the slightest leak in the barometer exists, it will infallibly bring the instrument to grief. In order, therefore, to be sure that the barometer was sound (before the water deprived of air was put in), I closed tap L at top and tap P; then, connecting the gutta percha tube with the "street water-works" pressure, I allowed it to enter the barometer till the included air was contracted to one-fourth of its length having a pressure of water under it of between 40 and 50 lbs. to the inch.

The barometer stood this internal pressure for ten hours without the air being forced out. I therefore concluded that if the barometer would stand this great pressure inside, it would stand 14 lbs. to the inch pressure on the outside, and without hesitation I filled it with the prepared water.

As the instrument is made by a gasfitter, it would be easy to put the whole of it together, Lambert taps included, and to prove it with some powerful water-pressure before the instrument is taken to the place where it is to be erected. Also the water deprived of air and covered with a stratum of olive oil in the tin can could be sent, if necessary, 100 miles away without the possibility of any air getting into it. If a gutta percha pipe is not to be had to fill the barometer, a piece of compo tube will answer every purpose, which, when done with, is none the worse for gasfitting purposes.

I shall conclude with some account of the action of the water barometer. In the *Philosophical Transactions* for 1832 is a description by Mr. Daniell of a water barometer which he erected at the Royal Society's Rooms, at Somerset House, which was in action for two years, but afterwards got out of order. In describing the action, Mr. Daniell states that "the water appears to be in perpetual motion, resembling the slow action of respiration."

I can fully corroborate Mr. Daniell in this particular, and from careful and continued observation am able to state that the times of the oscillations are about every four minutes and twenty seconds. It is requisite to watch the oscillations with a magnifier, as they vary from the twentieth to the thirtieth part of an inch, which distance can be well observed when magnified. But the most surprising oscillations in the water barometer are during a thunderstorm accompanied with great falls of hail and heavy rain drops. I have given a chart of five minutes' readings for one hour and five minutes during a heavy thunderstorm from the north-east, which passed over Birmingham July 20, 1859. The upper curved line shows the water oscillations, and the lower curved line shows the oscillations in the mercurial barometer. The temperature is recorded at the foot. It will be observed that while the water-column rose and fell in a most surprising manner, the mercurial column showed hardly any motion, which was of a laggard character.

At 4.20 p.m. the storm reached its climax, the heavens grew darker overhead, and the water rapidly descended, causing a most impressive feeling on the mind, when suddenly came a terrific blaze of lightning, instantly followed by the "thunder cannonade" (if I may so call it); then down came the hail and heavy rain, and as the sky began to brighten the water commenced to rise, and in the next five minutes it had risen more than four-tenths of an inch.

Since Sir John Herschel proposed his new theory—that the disruptive electric discharge is the result, and not the cause, of the sudden condensation of cloud into "rain drops," in consequence of the cloud coming in contact with an extremely cold and dry current of air—it has occurred to me that the sudden increase in the density of the air, as shown by the rise of the water-column, may be due to the sudden precipitation of rain-drops of unusual size, leaving the atmosphere drier and consequently denser; it being well established that the mercurial column is always high when the air is dry, and *vice versâ*.

I conclude this account of the water-barometer by stating that the object with which it is written is to give practical directions for the construction of these noble instruments with a view to their becoming common for the furtherance of meteorological science.

The total cost of the materials need not exceed 3*l.*, exclusive of gas-fitter's time.

Birmingham, November 14.

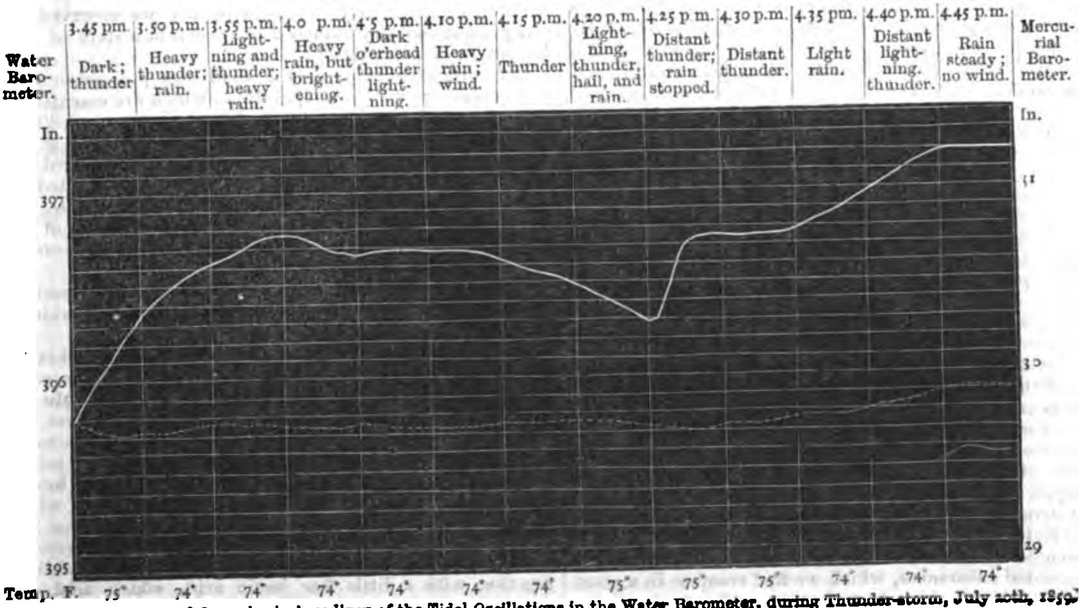


Chart of one hour and five minutes' readings of the Tidal Oscillations in the Water Barometer, during Thunder-storm, July 20th, 1859.

PROCEEDINGS OF SOCIETIES.

SOCIETY OF ARTS.

CANTOR LECTURES.

"On some of the most important Chemical Discoveries made within the last Two Years."

By Dr. F. Crace Calvert, *F.R.S., F.C.S.*

Lecture 3.

Tuesday, April 18, 1865.

On the Discoveries in Physiological Chemistry.—I intend in this lecture only to give you a general outline of some of the main facts connected with the phenomena of digestion and respiration, introducing as I proceed some of the most important chemical facts connected with that branch of science discovered or observed within the last two years. To enable you to appreciate more fully the importance of those discoveries, I shall divide my lecture under two principal heads—first, the studying with you those facts which have a special reference to digestion and respiration; and, secondly, those which have a more immediate connection with the human system in their direct action as therapeutic agents.

Digestion.—Man requires several varieties of food to maintain the health and strength of the body. One of the most important of these is atmospheric air, which is chiefly used to maintain the heat of the body so essential to vitality, by oxidising the various substances taken as food, or by oxidising the tissues which have been destroyed in the body by the wear and tear of life, and which, having fulfilled their functions, require to be removed, that new tissues may replace those which have disappeared.

The next class of food which man requires are fluids, which are chiefly represented by water, either pure or mixed with other substances, and which fulfil in the body two principal functions—that of carrying into the stomach and the intestines various nutritious elements which have been taken as food, and conveying them into the blood by endosmosis, or the force called by Mr. Thomas Graham, the Master of the Mint, "diffusion."

The second purpose which liquids fulfil in the human system is to remove from the blood those various substances which have been acted upon by the atmosphere, as above explained, or others which have been produced by the action of vitality, and which require also to be removed from the system to enable it to be in a normal state.

Again,—Man requires various mineral matters, but these must be of a peculiar nature, so as to render them fit to fulfil in the organism the different functions to which they are adapted. Thus we find that man requires soda, potash, lime, manganese, iron, chlorine, sulphuric acid, phosphoric acid, and other mineral elements of minor importance. No doubt that for man, as for plants, the nature and the relative proportions of the mineral matters entering into the food which he takes are most essential; for if in that food a sufficient amount of salts of soda were not present, one of the essential elements of blood would be wanting. If phosphate of lime is not supplied in due proportions, the frame-work of his body will suffer. The same may be said of the importance of carbonate of lime in the water which he takes as a beverage; and, therefore, it is yet a question to be solved by experience, whether the extremely pure water which is now introduced into several of our principal cities, such as Manchester, Glasgow, &c, so agreeable to the general feelings of the public, under the impression that it is pure water, and which confers such benefits on manufactures in general, will not, in course of time, prove detrimental to the health of the inhabitants, owing to its extreme purity, not containing carbonate of lime, which is so essential to the formation of bone in man and animals.

The fourth class of food that man requires may be called heat-producing or respiratory food. This food is chiefly assimilated and employed by him to maintain the heat of the body, through the action of the oxygen of the atmosphere, and which, being dissolved by the blood, circulates with it, and burns or oxidises its carbon, converting it into carbonic acid. This class of food is mainly represented by starches, gums, sugars, oils, fatty matters, and several other substances, such as pectic acid, pectose, &c.

The fifth class of food is flesh or blood-forming food, which is employed in the system to replace the various animal tissues which have fulfilled their functions, and which are modified and altered by the action of the oxygen of the atmosphere as above explained, or are destroyed by the tear and wear of life, and which leave the system principally in some modified state, by means of the fluid taken as a beverage. This class of food is represented by fibrine, albumen, caseine, and other similar nitrogenated substances, which we find compose in a great measure flesh, blood, milk, and other similar foods.

As it is impossible for me, in the course of one lecture, to give you a correct idea of the chemical phenomena involved in the digestion of the five various classes of food to which I have referred, I must confine my observations to the digestion of the two last classes of food,—namely, the heat-producing foods, and the flesh or blood-forming ones. The blending of chemistry with animal physiology has thrown much light on the phenomena of digestion; in fact, until chemistry had investigated many of the actions which take place in the digestion of foods, much obscurity existed, and many empirical views were promulgated on these important and essential functions of life. But since chemistry has penetrated into this branch of science, it has brought to light many facts which could not be understood or satisfactorily explained until the chemical facts connected with digestion had been well studied, and much light thrown on the complicated phenomena.

Although I do not agree in the opinion entertained by some persons that the phenomena of digestion are purely due to chemical actions, on the other hand, I am of opinion that they cannot be regarded as entirely due to the force called vitality. My opinion is that the phenomena of digestion are due to the simultaneous or successive actions of vital and chemical forces. Thus, for example, the secretion of the various fluids necessary for digestion is due to vitality, and the influence of the fluids secreted on the substances taken as foods is due to chemical action, or, in many instances, to actions not yet well understood, but which still come under the head of chemistry—namely, purely chemical fermentation. I understand by this term the peculiar conversion or unfolding which certain substances undergo by the presence or contact of minute quantities of other substances, such, for example, as the conversion of starch into dextrine and sugar under the action of the peculiar ferment called diastase, or the unfolding of amygdaline into hyduret of benzoil, prussic acid, &c., under the influence of a ferment called emulsine. But we must bear in mind that this class of fermentations are perfectly distinct from those which I described to you in the last lecture of my course delivered in 1864, which fermentations referred to those which are determined or produced in consequence of the development in the fluids of certain microscopic vegetables or animals which, by their peculiar mode of growth or life, determined the changes which are observed in many vegetable and animal fluids when in a state of fermentation or putrefaction.

With these explanations I shall now proceed to state that there are five principal fluids which are essential to digestion, and which are secreted by various organs which participate in the actions which take place during digestion, and these are:—1. *Saliva*, which is secreted by certain glands in the mouth; 2. *Gastric juice* secreted by the membranes of the stomach; 3. *Pancreatic juice*, secreted by a gland situated just beyond the outlet of the stomach; 4, *Bile*, secreted by the liver; 5, a *Gaseous medium*, called atmospheric air.

Let us now examine how and to what degree each of these fluids acts upon the two special classes, and which I have stated are blood and heat-forming foods.

Animal Food.—When meat, for example, is taken as a means of subsistence, although it is divided into small pieces by mastication, and gradually brought into the form of a ball, so as to pass with facility from the mouth into the stomach, still it undergoes no chemical change by the mixing or imbibition of the saliva. But when it arrives in the stomach, it meets there a very acrid fluid called gastric juice, the acidity of which is due, not to hydrochloric or acetic acids, as was formally stated, and which are now attributed to indigestion, but to the presence of phosphate and lactate of lime, together with a little free lactic acid, which acid elements are essential not only to the action of the ferment called pepsine, but also facilitates its solution. This pepsine acts in a most remarkable manner, for a minute trace of it appears to have the power to liquefy, if I may so express myself, the solid substance called fibrine, and to alter its conditions. In fact, all the solid animal elements of food become fluid under the action of the gastric juice, and are transformed into the fluid mass which has received the name of albuminose or pectose. The animal matter so transformed is susceptible of being absorbed either by endosmosis or diffusion by the coats of the stomach; but the greatest part of it passes on into the small intestines, where it meets the bile, and where the acidity of the fluid is neutralised and it becomes alkaline owing to the alkaline state of the bile. This transformation of the acidity of the gastric juice into an alkaline character, is essentially owing to the fact that during its passage through the small intestines it is in a fit state to be absorbed by the mucus which coats those vessels of the human organism, and to come in contact with the blood, which is always in an alkaline condition. Further, we know that organic matter in an alkaline condition enters more rapidly into decay and decomposition, so that it is thus in a fit state to be rejected by the body. Therefore, in the digestion of animal matters, we may consider there is only one active fluid which participates in it—namely, gastric juice—pancreatic juice and the bile only acting as alkaline fluids to bring it into a proper state to be absorbed by the mucus, and to be carried by the blood into the torrent of circulation.

Here I must pause in my description of digestion to make you acquainted with some of the recent discoveries which tend to prove that gastric juice does not simply liquefy fibrine and caseine, but that it acts also on albumen in such a way as to modify its molecular condition, and thereby its chemical properties. If the albumen of an egg be injected into the jugular vein it passes unaltered to the blood, for it is found in the secretions of the kidneys. It follows that albumen of the egg must undergo a molecular change to render it fit to become assimilated, and we may assume, therefore, that it experiences the same change in the stomach under the influence of the ferment, called pepsine. But I cannot conclude this part of my subject without calling your attention to some interesting researches lately published by Mr. Smee. Until the publication of those researches, although scientific men had assumed that there must be an identity between albumen, fibrine, and caseine, which are the chief elements representing animal food, still they had not been able to demonstrate their convertibility one into the other. Now, Mr. Smee has accomplished that fact; or, in other words, has reversed the theory previously entertained as to what takes place during digestion; for he has established that fibrine, or the clot of blood; caseine, or the curd of milk; and albumen, the serum of blood, are convertible into one fluid, which he has called albumenose, or pectose. Mr. Smee has succeeded, I say, in reversing the problem, and has shown that albumen may be converted into fibrine, and probably caseine. To effect this interesting change he proceeds as follows:—He passes a current of pure oxygen gas through a solution of albumen of blood or egg, slightly acidulated with acetic acid, and at a temperature of blood heat, or of 98° to 100°, and after several hours a mass of fibrine appears, the production of which is facilitated by bringing into play the action of an electric current. If instead of an acid solution of albumen, Mr. Smee employed a weak alkaline solution of the same substance, it became transformed into a peculiar substance which I described to you in my last year's lecture, under the name of chondine. But I would strongly recommend to all lovers of animal physiology to read the interesting papers which have been published by that gentleman in the *Proceedings* of the Royal Society, 1864 and 1865.

Fatty Matters.—Allow me now to have the pleasure of calling your attention to the modifications which fatty matters have to undergo when taken into the human system, before they are prepared for assimilation. Most physiologists maintain, at the present day, that these substances undergo a change during their retention in the mouth or their passage into the stomach, but Dr. Marcet is of opinion that fatty matters undergo a certain modification during their passage from the mouth to the entrance of the small intestines. At all events, there can be no doubt, from the researches of some of the most eminent physiologists, that fatty matters undergo a most important change when they arrive in contact with the fluids secreted by the gland called the pancreas, which transforms them into an emulsion, but does not saponify them. The matters so emulsioned are then further acted upon by the bile, and finally are absorbed by the lacteal vessels, and carried into the circulation of the blood. It is the absorption of fatty matters by the lacteal vessels which deceived the physiologists of an earlier date, and led them to believe that that white substance was the absorption of the nutrient parts of food, to which they gave the name of chyle, and which, according to them, gradually became transformed into the element of blood. Fatty matters so absorbed and carried into the torrent of the circulation of the blood fulfil two purposes—either they are consumed through the oxidation of the oxygen contained in the air inspired, and thus they help to maintain the heat of the human body, or they are stored up with the view of supplying the elements necessary to the maintenance of the heat of the body, when, through disease, the body has ceased to take its ordinary external nourishment. In fact, we may consider these fatty matters to be to the body what the coal fields of England are to its manufacturers.

Another division of the heat-forming or respiratory foods is that to which I have already referred, and which includes starch, gum, and sugar, and the transformations which these peculiar substances, and especially starch, undergo in order to become assimilated. Allow me to claim your undivided attention to the facts which I am now going to bring forward. When bread, potatoes, or any amylaceous substance, arrives in the mouth, it gradually becomes mixed and saturated with saliva—1st, the saliva of mastication, which is secreted by the parotid glands, and serves only to coat the mass of food called the ball, and so facilitate its passage into the stomach; 2nd, the saliva which is secreted by the submaxillary glands, a thin, watery fluid, which acts chemically on the food, converting the insoluble starch into soluble elements called dextrine and sugar. The amylaceous substance thus acted on passes into the stomach without further action, but when it arrives in contact with the fluid secreted by the pancreatic glands, there it undergoes a complete change; for the pancreatic fluid, called by the Germans the intestinal saliva, completes the conversion into dextrine and sugar of such portions of the starch as have not been acted on by the saliva of the mouth. For both these fluids are alkaline—I mean the pancreatic fluid and the saliva from the sub-maxillary glands; for that secreted by the parotid glands is acid, and this explains why the saliva is always acid in the morning, or before man has taken food. I say that these fluids are alkaline, and they contain a ferment called diastase—a ferment identical with that which exists in malt, and which converts in the brewer's vat his mash into a saccharine fluid, which ultimately becomes beer. The starch so converted into dextrine and sugar through the action of the diastase of the saliva and of pancreatic fluid, is absorbed by the mucus of the small intestines, and conveyed by the small veins which line those organs into the vena porta, and thence into the liver. This important organ fulfils several functions. First, it secretes bile, an alkaline fluid, which, as we have seen, acts as a neutraliser of the acid fluids arriving from the stomach, converting them into an alkaline condition fit for decay. Secondly, it is an eliminating organ, for the bile appears to contain some of the elements which require to be removed from the blood, and which have been produced through the wear and tear of life. Further, it contains some of the elements of the colouring matter of blood, for the colour of bile and that of the blood appear to have a resemblance. But the most important substance which the liver contains is a peculiar ferment, discovered by M. Claude de Bernard, which has the power to transform the insoluble substance which he calls glycogen into a soluble one, namely, sugar. Thus, it would appear, from the researches of that eminent physiologist, that the amylaceous substances absorbed as food, and acted on as above explained, arrive by the vena porta in the liver, and there are stored until required by man to maintain the heat of his body and the phenomena of life. He has observed—and the results at which he has arrived have been confirmed by C. G. Lehmann, another eminent physiologist—that there is comparatively only a small amount of sugar in the blood when it passes into the liver by the vena porta, whilst the same blood, when it leaves the liver by the hepatic veins, contains a comparatively large quantity. Thus, Lehmann has found that the quantity of sugar in the vena porta blood amounts to from 0·21 to 0·30, whilst in the hepatic veins the quantity is from 0·87 to 0·98; and that the hepatic blood so charged with sugar first passes into the right ventricle of the heart, then into the lungs, thence into the right ventricle of the heart, whence it is driven, by the contraction of that organ, into the torrent of circulation. I say "the torrent of circulation," and as perhaps few persons are aware with what rapidity blood circulates through the human system, it may be interesting to state that every time the heart contracts about three ounces of blood are driven out, and as there are about sixty pulsations of the heart per minute, the consequence is that the 33 lbs. of blood which is contained in the body of an adult passes through the whole of his system—lungs, heart, kidneys, liver, and even through the most minute capillary vessels—in the space of three minutes. The knowledge of this fact will explain how small quantities of matter coming in contact with the blood may produce a most injurious action on the system—how, for example, the smallest quantity of strychnine, curorine, prussic acid, and other such substances, can act upon the blood, modify its nature, and produce death in a few minutes.

The curious substance called glycogen by Claude de Bernard, was extracted by him from liver, by the following process:—The liver of an animal recently killed was cut into thin slices and thrown into a small quantity of boiling water. The whole was allowed to boil for an hour, and was then submitted to pressure. A small quantity of fluid was obtained, which, when treated by alcohol, yielded a white flocculent precipitate, and this, when re-dissolved in water, and re-precipitated by alcohol, was then found to yield with iodine and other re-agents the characteristic properties of amylaceous substances. Although glycogen exists in larger quantities in the liver when man or an animal takes a large quantity of amylaceous substances as a part of food, still this substance is found in the livers of carnivorous animals, showing that under the force called vitality animal matters are susceptible of undergoing the chemical change which converts them into a substance similar to starch. But this glycogen gradually disappears from the blood as it passes from the hepatic veins into the heart, and lastly through the torrent of circulation, for the oxygen of the atmosphere rushes into the lungs by inspiration, gets into contact with the blood in the numberless cells composing them, and by its action upon the glycogen helps to convert it into water and carbonic acid gas, which are thrown out by expiration. Now, although this conversion of the glycogen proceeds during the whole of the circulation of the blood, still there can be no doubt that the greatest portion of it is converted into gaseous elements when it comes in contact with the oxygen of the air in the cellular tissues of the lungs, for much less oxygen is found in arterial blood than in that of the hepatic veins.

To smooth the pathway of the reader to the perfect understanding of the above statement, it is perhaps necessary to add that when the blood leaves the liver it travels through the hepatic veins into the right ventricle of the heart; that by the contraction of that organ the venous blood is thrust into the lungs, where it comes in contact with the oxygen of the atmosphere, and is converted from the dark purple colour which characterises venous blood into a brilliant red-coloured fluid, called arterial blood. Having undergone that change, it runs thence into the left ventricle of the heart, and, having filled it, that organ contracts itself, and drives the blood with great force through the whole of the arterial system, and during its passage through the capillary vessels it gets converted gradually into venous blood, which reaches through the various veins the vena porta, and this conveys it to the liver. Thus, we can perceive how the blood constantly flows in a circular motion through the whole of the human system. At all events, before proceeding with the few remarks I have to offer on respiration, and calling attention to recent discoveries which have been made in connection herewith, allow me to state that Lehmann has published the following data respecting the action of the liver on the various elements contained in the blood. He has found that there is much more fibrine in the vena porta than in the hepatic veins; that albumen is more abundant in the portal than in the hepatic veins; that fatty matters are in larger quantities in the portal than in the hepatic; that globullin, or the substance which represents the globules of blood, is in less quantity in the portal than in the hepatic; whilst the colouring matter, called hematozine, is in larger quantities in the portal than in the hepatic. This, according to Lehmann, explains why we find colouring matters in bile, which may be considered as modifications of the one existing in blood, and which are found only in that fluid.

(To be continued.)

ACADEMY OF SCIENCES.

November 27, 1865.

Does ozone exist in the atmosphere? That is the question asked by Admiral Berigny, who, having patiently made what he conceived to be ozonometric observations for the last ten years, and after having assisted M. le Verrier in selecting stations for similar observations all over Paris and in every department of France, has been brought at last to doubt whether the observations are good for anything; so he beseeches the Academy to appoint a commission to settle definitively,—1, whether ozone exists in the atmosphere; 2, whether Schönbein's or anybody else's papers prove the presence of electrised oxygen; and, lastly, whether an easy and reliable method of detecting it could not be devised. The Academy appointed a commission composed of Chevreul, Dumas, Pelouze, Pouillet, Boussingault, Le Verrier, Valliant, Frémy, and E. Becquerel, whose report will not doubt scatter popular notions on atmospheric ozone to the winds.

To say the truth, the evidence in favour of the presence of ozone in the atmosphere is, as M. Frémy showed to the Academy, of the most doubtful character. M. Frémy said that he knew of only one certain test for ozone in the air, and that was the oxidation of silver, by passing a current of moist air over the metal; and this test he had applied many times without obtaining any indication of ozone. We are very far from being acquainted, he said, with all the bodies held in suspension in the air, and, consequently, ignorant of the action they may exert on iodide of potassium. May not, he asked, this salt become alkaline, or set free iodine under other influences besides that of ozone? He did not deny the fact of its presence, but he asked a positive proof of it. Such a proof is required; for seeing that ozone is instantly destroyed by organic matters, and absorbed by nitrogen, it is difficult to understand how such a body can continue to exist in the air, which contains precisely the elements which would at once change the ozone. As regarded the test-papers, he asked, what use there could be in a re-agent which was affected not only by ozone, but by the oxygen compounds of nitrogen, by oxygenated water, by ammonia, by formic acid, by essential oils, by the acid products of combustion, by dusts,—in a word, by all sorts of things which are held in suspension in the air.

M. Soret presented a note entitled "*Researches on the Density of Ozone.*" Our actual knowledge of the volumetric relations of oxygen is limited to the following facts:—1, that ordinary oxygen diminishes in volume when a part is converted into ozone; 2, that when ozonised oxygen is treated with iodide of potassium or other oxidisable matter, the ozone disappears without any alteration in the volume of the gas; and, 3, that under the influence of heat ozonised oxygen undergoes an expansion equal to the volume that the part absorbable by iodide of potassium would occupy. Regarding a molecule of ordinary oxygen as composed of 2 atoms of OO, the author considers the molecule of ozone as consisting of 3 atoms OO,O occupying the same space as the two. Treated with iodide of potassium, ozone loses one atom of O without any change of volume; submitted to heat, the volume is increased by one-half. Thus the theoretical density of ozone should be one and a-half times that of ordinary oxygen, or 1·658, and the author considers he has experimentally demonstrated that such is the fact. We shall give his experiments next week.

Dr. C. T. Jackson sent "*An Account of the Gold and Silver Mines of California.*" The account is destitute of any scientific interest.

M. Liais sent some observations and calculations by which he has proved that the tail of the great comet of 1861 mixed with the atmosphere of our earth.

M. Maumené sent a note "*On Bichloracetic Acid.*" The chlorinated aldehydes have a general action on water, which may be represented *in its results* by the formulæ—

$$C_4H_3Cl\,O_2 + 2HO = C_4H_4O_4 + HCl.$$

$$C_4H_2Cl_2O_2 + 2HO = C_4H_3ClO_4 + HCl.$$

• • • • •

$$C_4Cl_4O_2 + 2HO = C_4HCl_3O_4 + HCl.$$

The third term of the series was wanting until now. The author shows that chloral, instead of decomposing $2HO$, unites with them to form a hydrate; and this hydrate, $C_4HCl_3O_2,2HO$, when submitted to the action of oxide of silver in a bath of ether, forms bichloracetic acid $C_4H_2Cl_2O_4$. The same acid is also obtained when rough chloral, prepared with badly-dried chlorine, is submitted to distillation. The product begins to boil at 85° C., and the temperature rises continuously. If the receiver is charged at 170° almost pure bichloracetic acid is obtained.

M. Boudin sent a paper "*On Deaths by Lightning and their Division between the Sexes.*" In a former paper the anthor showed that more men than women were killed by lightning in France. He now adds statistics for 1864, in which year 87 people were killed, 61 males and 26 females. Putting together his figures, and making a guess for the three new departments, he calculates that in the period of thirty years there have been in the France of to-day 2431 deaths by lightning. He adds, that the total number of individuals injured is at least four times that of the number killed outright. Thus, the whole number struck from 1835 to 1864 inclusive must have been 12,000, or 400 a-year. From 1854 to 1864 inclusive 967 people were killed in France, 698 being males and 269 being females. The females, therefore, only constitute 28 per cent. of the victims. In England, M. Boudin adds, the proportion of females is even lower, being only 22 per cent. Referring to the circumstance that when lightning has struck a group composed of individuals of both sexes the men have been killed and the women escaped, M. Boudin is at a loss how to account for this comparative immunity of the female sex. Might not the explanation be found in the fact that men are, on the average, taller than women?

NOTICES OF BOOKS.

Annales de Chimie et de Physique, October, 1865.

This number contains the conclusion of M. Semenoff's paper "*On the Law of Volumes in Double Decompositions.*" We have already had occasion to notice this paper in the reports of the Academy of Sciences, and need not again refer to it. The next is a translation of Magnus's important memoir "*On the Difference Between the Heat Radiated from Polished and from Unpolished Surfaces.*" The author made the important observation that a plate of platinum covered with platinum black radiated twice as much heat as a plate of polished platinum of equal extent; and on analysing the radiations he discovered that the increase of heat from the unpolished metal is not due to a regular increase in all the rays emitted, but that the red, and especially the ultra-red, rays are chiefly augmented in intensity. The whole paper will be read with great interest, and especially the author's final considerations on the identity of heat and light.

The paper which follows is M. Jeannel's "*Researches on Saturated Saline Solutions.*" We have already mentioned the conclusions at which this author has arrived.

The next is a paper, by M. Musculus, "*On Dextrine,*" being a reply to a paper by M. Payen. Real dextrine is a body which, according to M. Musculus, has seldom been seen, and hence the confusion in different accounts of its properties. The author contends that starch, when boiled with dilute acids, splits up at the same moment into dextrine and glucose, and that it is not a fact that dextrine is first formed and then glucose. The way, therefore, in which he prepares dextrine is as follows:—He first boils the starch with a dilute acid until it no longer gives a blue or red colour with tincture of iodide: he then saturates the acid, and ferments with well-washed yeast. When the fermentation is finished, he filters the liquor and evaporates to dryness. The residue he washes with alcohol several times, and preserves it in well stopped bottles. This residue is true dextrine. It is a gummy substance, which strongly attracts moisture. It is very soluble in water, but quite insoluble in spirit. It does not reduce cupro-potassic tartrate; diastase has no action upon it. Its rotatory power is nearly three times that of glucose.

The valuable paper by M. V. de Luynes, "*Researches on Orcine,*" follows. We gave some account of this paper at page 225 of our last volume.

An account of the next paper, "*On Sucrates,*" by MM. Boivin and Loiseau will also be found in our last volume.

We have noticed more recently the paper that follows, "*A Comparison of the Reactions of Iodide of Potassium, and Alkaline Chlorides and Bromides,*" by M. Payen. The next paper, by Dr. Bœckel, "*On Ozone as a Meteorological Element,*" confirms the observations of M Houzeau and Admiral Berigny (see pp. 201, 204 of our last volume), but adds to them a little, so we shall give the author's resumé on a future occasion.

The journal concludes with a part of Melsen's second memoir "*On the Use of Iodide of Potassium in Metallic Poisoning.*" We shall give an abstract of this paper in an early number.

A letter of M. Béchamp to M. Dumas mentions that creosote appears to be the agent which most strongly opposes the *development* of organic ferments, but adds that it does not interfere with the life of ferments or animalcules when they are once developed.

Bulletin Mensuel de la Société Chimique de Paris, &c., &c. November, 1865.

In this Journal we find the laws of the Chemical Society of Paris, as recently revised and confirmed by the Minister of Public Instruction. Some of these are peculiar, and worthy of mention. We find, for example, that in addition to the ordinary meetings of the Society, a certain number are to be held every year which are to be open to the public, and at which the authors of useful and important discoveries are to be asked to give an account of their works, with experiments when necessary to illustrate the subject. We see, also, that the Society, wishing to do everything possible towards the progress of chemistry compatible with its mode of organisation, thinks of publishing the works of the older chemists (foreign as well as French) in as complete a manner as may be possible or useful.

Among the memoirs presented to the Society we find the third part of M. Joulin's memoir "*On the Potash and Soda of Stasfurth;*" and also the first part of M. Kopp's memoir, "*On the Utilisation of Soda Waste and Chlorine Residues.*" Of this second paper we shall immediately give as full an abstract as is necessary after the author's letters which have appeared in our pages.

M. A. Keller communicated to the Society some *Remarks* on a note by MM. Moutier and Dietzenbacher "*On a New Property of Sulphur.*" Our readers will remember that these gentlemen stated that sulphur could be rendered soft and plastic by fusing it with a trace of iodine or some paraffine, lamp black, &c. M. Keller has tried every one of the substances named, but has never succeeded in producing the result stated, unless he poured the sulphur either into cold water or in a very thin layer on a very cold porcelain tile, under which circumstances sulphur alone is always made soft and plastic.

In the abstracts of foreign memoirs we find a few novelties, which will have a place in our columns.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

2106. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the preparation or production of spongy metals, and in their applications."—A communication from F. Drivet, Turin, Italy.—Petition recorded August 15, 1865.

2482. C. H. L. Wintzer, Osnabrück, Hanover, "Improvements in separating phosphorus from iron and other metals in metallurgical processes."—Sept. 27, 1865.

2682. W. Beardmore, Parkhead, Lanark, N.B., "Improvements in furnaces."—Oct. 17, 1865.

2870. F. Prange, Liverpool, "Improvements in the manufacture of steel."—A communication from J. Rosenthal and F. Gierow, Berlin, Prussia.—Nov. 7, 1865.

2950. A. V. Newton, Chancery Lane, "An improved manufacture of caramel."—A communication from T. Hyatt, New York, U.S.A.—Nov. 16, 1865.

2953. S. H. Huntly, Upper Baker Street, Regent's Park, "Improvements in apparatus for obtaining fresh water from salt and impure water, also applicable for ventilating purposes."

2963. T. M. Tennant, Edinburgh and Leith, N.B., "Improvements in furnaces."

2964. W. E. Newton, Chancery Lane, "An improved process for hardening malleable and non-malleable cast-iron."—A communication from T. H. Jenkins, New York, U.S.A.

5965. J. Harbert, Kidderminster, "Improvements in the production or manufacture of gas for heating or illuminating, and in the retorts and apparatus employed in such manufacture."—Nov. 17, 1865.

2998. W. Wells, Manchester, and S. Marland, Clayton, near Manchester, "Improvements in apparatus for obtaining artificial light from volatile liquids or fluids."

3002. S. A. Bell, Epping Villas, Stratford, Essex, "An improvement in the manufacture of friction matches and tapers."

3007. J. J. Field, Upper Gifford Street, Caledonian Road, Middlesex, "Improvements in the manufacture of soap."—November 22, 1865.

Notices to Proceed.

1905. J. H. Chaudet, Rue des Emmurées, Rouen, "An improved system of manufacturing salts, sulphates, and acetates of chrome, and of applying them as mordants in dyeing and printing textile substances, both animal and vegetable."—Petition recorded July 21, 1865.

1914. J. P. Gillard, Paris, "Improvements in the manufacture of soda and carbonate of soda."—July 22, 1865.

1946. T. Pepper, Newington Green, Middlesex, "Improvements in the manufacture of anti-inflammable starch."—July 26, 1865.

2040. A. Millochan, New York, U.S.A., "An improvement in stills for the distillation of petroleum and other oily substances."—August 5, 1865.

2903. W. E. Newton, Chancery Lane, "Improvements in making amalgams or alloys of metals." A communication from H. Wurtz, New York, U.S.A.—Nov. 11, 1865.

CORRESPONDENCE.

Continental Science.

Paris, November 30.

On resuming my letters, it is most disagreeable to find that the first thing which I think demands notice is some correspondence from England, published in *Cosmos*, which reflects no credit on one of the parties concerned. There is no necessity for the suppression of names, so I may state plainly that in relating the poisoning of the two assistants at St. Bartholomew's, Dr. Phipson took occasion to make a most uncalled-for attack on Dr. Frankland, who is represented as wilfully causing the death of one and the illness of the other gentleman. The letter caused some sensation here, and while everybody laughed at Dr. Phipson's estimate of Dr. Frankland as a chemist, some indignation was expressed at the apparent want of humanity he was accused of displaying. I need hardly say that there were a few here who knew—what I should have thought every chemist in London would have known—namely, that Dr. Frankland had left St. Bartholomew's for some years, and therefore that the charges could not apply to him.

Dr. Frankland's own denial soon arrived, but that (probably from the fault of the French translator of the letter) seemed to deny that any such cases had happened, and caused some misconception for a moment. Dr. Odling, however, has cleared the matter up by the frank statement that the occurrences happened in his laboratory, and that no one was to blame. And now Dr. Phipson must get out of the business as he best can.

One object Dr. Phipson had in view, it seems to me, was to frighten foreign assistants from seeking engagements in London laboratories. He might as well try to frighten Germans from enlisting as soldiers wherever there is fighting to be done. Germany produces more men and chemists than are wanted at home, and they must go somewhere to live; and in my time I know foreign assistants had nothing to complain of in London. They were as well paid as the English, and although, as a rule, rather given to a spirit of detraction, they seemed in general contented.

I will dismiss the matter at once by stating, while Dr. Phipson has not increased his scientific reputation, he has acquired a reputation for something else which, I fancy, will by no means improve his standing in London.

There is really little of novelty or utility to communicate at present. M. C. Schaitner describes in *Cosmos* what is called a new process for extracting vegetable oils, such as those from cotton and linseed, poppy, mustard, and other seeds. The seeds are first crushed or partly pressed, and then the cakes are digested (with or without heat, as need be) in closed vessels with the lighter petroleum oils. The matters are then pressed or percolated with fresh oil, and the oily solution is submitted to distillation. The petroleum oils should be such as distil below 100° C., and therefore easily separated. I need not describe the process further. Any one will see how to carry it out if it be of any use.

That matter is not infinitely divisible is a recognised belief, yet no one has ever seen, or is likely to see, an ultimate molecule or atom. Nevertheless, M. Loschschmidt has measured one—at all events, on paper. By a process of reasoning of which I need not give you any account, he has arrived at the conclusion that the diameter of the molecule of a gas is about the millionth part of a millimetre, or the seven hundredth part of the length of a wave of red light. A cubic millimetre will therefore contain 866 billions of such molecules; or if the gas were condensed to a liquid, a trillion. A trillionth of a milligramme, he believes, will represent the atomic unit of weight.

Commercial and Scientific Analyses.

To the Editor of the Chemical News.

Sir,—Allow me a few lines to reply to a grumbling critic, Mr. Denham Smith, who, in the Chemical News of November 24, makes a desperate attempt to "cut up" my paper on the new phosphate rock of North Wales; and in the next number (December 1) vents his spleen upon Mr. Carter Bell, the author of an interesting paper on Alum, lately published in your valuable journal.

As far as my own case goes, the very fact criticised—namely, the deduction of chemical formulæ from commercial analyses made in my laboratory—simply proves that these analyses are done with more than ordinary care; and if Mr. Denham Smith is of opinion that analyses on which large pecuniary interests are at stake should not be made with as much accuracy as possible, I beg to differ from him entirely, and to assure him that when a commercial analysis is entrusted to me it receives just the same attention, to ensure accuracy of results, as if it were a research of a purely scientific nature. If, instead of grumbling at what others do, Mr. Denham Smith would endeavour to produce something himself, it would be "more becoming." When I compare my note upon the new phosphate rock with his column of nonsense, I apply to a critic of "his stamp" a slightly modified edition of the old French saying, "*Je ne suis pas si bête que vous avez l'air!*"

I am, &c.
T. L. Phipson, Ph.D., F.C.S., &c.

4, The Cedars, Putney, London, S.W.

The Vacant Chemical Professorship at Oxford.

To the Editor of the Chemical News.

Sir,—Could not the University of Oxford usefully imitate the College of France, and change the Aldrichian Professorship into one of Organic Chemistry? Modern chemistry can be studied from two points of view; and in these days, perhaps, the *science* could be best taught by the exclusive consideration of the so-called organic compounds. Mineral chemistry would be mainly occupied with its technological applications; but with these the principles of the science would of course receive full illustration.

I am, &c., Chemicus.

December 5.

New Cornish Minerals.

To the Editor of the Chemical News.

Sir,—My attention has been called to the report in your journal of November 10 of the meeting for that week of the Chemical Society, in which I find my language rather erroneously reported. I must therefore ask you to correct the doubtless unintended distortion of my words in so far as it has any scientific bearing.

I did not say that the hydrated cerium phosphate occurs in square prisms, which, of course, would imply its being pyramidal.

The chemist who introduced the mineral, and who spoke before the Society with a diffidence on the crystallographic part of his subject that might have been well adapted in the paper recently printed in the *Journal*, stated that he had sent it to Professor Miller at Cambridge, who, however, could not meet with any angles good enough for measurement. He also stated that he had himself at first taken the mineral for wavellite. I mentioned that Mr. Talling had long ago sent me a mineral which I thought likely (and which proved) to be the same, and that he had sent them as wavellite, but with a doubt on this point. I added, that on one of the bits Mr. Talling had sent me (which were in every respect inferior to the specimen shown to the Society) I had found one little splinter-like crystal presenting the bright plane, with two others, that, though very poor, seemed real planes; that one of these (apparently a prism plane) gave a tolerable measurement of 90° with the brilliant plane, and the other a measurement with it of nearly 90°, but oscillating on each side of 90°. The specimens themselves were not at all like the Stennagwyn wavellite, and these measurements made the resemblance still more problematical. Furthermore, with my absolute want of every sufficient means of making a qualitative analysis or even a blowpipe experiment in the British Museum, I was able only to establish the fact of the mineral being a phosphate.

On these grounds I could only endorse Mr. Talling's query. There being no grounds whatever at present for calling the mineral oblique, much less to assign a symbol to any plane on it, I said it was quite as likely to belong to one of the rectangular systems.

I am, &c.,
Nevil Story Maskelyne.

British Museum, November 30, 1865.

MISCELLANEOUS.

The Copper Smoke Question.—It is well known that the utilisation of copper smoke has attracted great attention of late years, and only a few weeks ago particulars of a German invention in course of adoption at Messrs. Vivian and Sons' works, Swansea, were given in the *Times*. Mr. H. H. Vivian, M.P., announced at a public meeting since held that he had every confidence in the success of the invention, and that in a short time the copper smoke from his works, which had hitherto been so injurious to the land around, would not only be rendered innoxious, but of great commercial value, by condensing it through various processes to sulphuric acid. Within the last few weeks Mr. Thomas Bell has brought forward another invention, which, since his letters in the *Times*, has attracted considerable attention. That gentleman has visited Swansea, the seat of the copper smelting trade, and he was introduced to the copper smelters at the last ticketing meeting, when he laid his plans before the parties then present, and he was invited to visit several of the principal local establishments in order to test the invention. From these facts it is inferred that before long the injury caused by the copper smoke will not only be neutralised, but the smelters will reap a handsome return from its utilisation.—*Times*.

Use of Ammoniacal Liquor to Remove Sulphur from Gas.—In the last number of the *Journal of Gas Lighting*, &c., Professor Anderson gives the following summary of the results of some experiments made at the Taunton gas-works:—"1. That in the experiments conducted at Taunton gas-works, when the sulphur was reduced by "scrubbing" (with ammoniacal liquor) from the proportion 19·8 grains to 12·92 per 100 feet, the illuminating power of the gas so treated underwent no deterioration of illuminating power. Further experiments, made with all the precautions which such operations on the large scale would admit of, contribute very much to show that the illuminating power of the gas is actually increased by the operation. 2. That the results obtained at Taunton gas-works are confirmed by other experiments, in which, whilst it was found that over 50 per cent. of the sulphur in the form of bisulphide of carbon was removed by the "scrubbing," the illuminating power of the gas was somewhat increased." The above results, we may say, understate the results obtained at other gas-works—Nottingham, for example—where we believe it has been found that nine-tenths of the sulphur is removeable by scrubbing with ammoniacal liquor.

Treatment of the Cattle Plague with Alkaline Sulphites.—We are glad to find that the treatment we recommended when the presence of the cattle plague in England was first made public has been adopted with some success,—at all events, as a prophylactic measure. A correspondent writes to the *Daily Review* that all the animals dosed with sulphites before an attack recovered, while all those not dosed died. We learn from wholesale chemists that the sulphites are just now in great demand, and we hope they will have extensive trials.

Gun-cotton.—The Vienna correspondent of the *Times* says:—"By order of the Emperor the use of gun-cotton by the Austrian artillery and corps of engineers is prohibited. If the cotton now on hand cannot soon be sold it is to be destroyed. A few years ago forty batteries of eight guns were made, all of which were to be charged with gun-cotton instead of powder, and now they must be re-cast."

British Rainfall.—Mr. G. F. Symons writes to us:—"I have to ask your readers' attention for a few moments to a request on the above subject, the importance of which in relation to engineering and drainage questions is well known. It is now some years since I began collecting returns of the fall of rain; but my main difficulty has been to find out the persons who keep such records, and one of the most obvious sources of assistance is the public press; I now, therefore, ask from each and every journal in the British isles their all-powerful aid. When the collection was first organised, in 1860, scarcely 200 persons were known to observe and record the rainfall; by steady perseverance and the aid of a portion of the press, the number has been raised until there are now more than 1200 places whence returns are regularly received. Still, I know there are many more, probably hundreds, who have either never heard of the establishment of a central depôt to which copies of all rain records should be sent, or they have been too diffident to send them. It is of paramount importance to gather these, and make the tables yet more complete. I therefore beg leave through your columns to ask every reader to think for a moment if he or she knows of any one who keeps, or has kept, a rain-gauge; or who has any tables of rain-fall (or old weather journals) in their possession. And if they do know of such persons, I ask them on behalf of science, of my fellow-observers, and on my own behalf, to use every effort to secure their assistance, and to favour me with their names and addresses. We want old records, we want records for the present year, and from many parts of the country we want returns for the future, if a few persons will notify to me their willingness to assist, and to pay 10s. 6d. for the very cheap and simple gauge now supplied." Mr. Symons' address is 136, Camden Road, N.W.

Popular Scientific Teaching.—Chemists must laugh as well as other men, and therefore we make no apology for introducing the following quotation from the second of two lectures, "On the Chemistry of Nature," delivered at Ryde, to the Isle of Wight Philosophical and Scientific Society, by G. F. Harrington, Esq., L.D.S.:—"I have already explained that a large proportion of the earth's atmosphere consists of compound inflammable gas; indeed, some philosophers have gone so far as to say that if the nitrogen were to be withdrawn from the atmosphere the remaining portion would combine with the earth's surface in a general state of violent conflagration. This being the case, is it reasonable to suppose that the earth is depending for light and heat upon the sun, which is 95,000,000 miles away, when it has all the materials necessary for its own illumination and warmth within a few miles of its own surface? I trust I have advanced a sufficient number of facts, and deduced a sufficient number of arguments from them, to prove that philosophers are mistaken in supposing that light and heat come from the sun in mechanical association with the "actinic" chemical rays, which I call chemical or ignipotent power. Surely, if it be admitted that active chemical power (*alone*) comes from the sun, as I am contending for, there can be no great difficulty in understanding that such power, while passing through the earth's atmosphere, excites the inflammable matter contained therein into a state of combustion to supply the earth with the light and heat it receives. If this be admitted, all further difficulty in understanding the chemistry of nature is at an end. Instead of the wasteful, destructive consequences involved in the received theories, which I have endeavoured to expose, each heavenly body would supply the proper fuel, at the proper time, and in the proper quantity for its own illumination and warmth, they depending on their suns, and their suns depending upon them for an exchange of chemical power to excite and govern the combustion necessary for their respective requirements; in which case Mercury, instead of being in an incandescent state, and Venus in a boiling state, the surfaces of those planets may possess the same degrees of temperature as the earth possesses; and instead of Mars, the asteroids, Jupiter, Saturn, Herschel, and Neptune existing under the influence of insufferable cold, their supply of fuel may return them suitable temperatures for the existence of similar descriptions of animal and vegetable life with those existing on the earth; and the same with the sun itself. Permit me to invite you, on the first clear, bright day, to satisfy yourselves that combustion is actually going on in the earth's atmosphere continually. This may be done as follows:—If you will stand with your backs to the sun, and look in a vacant manner for a minute or two towards the cerulean sky, you will discover an infinite number of infinitesimal but very distinct meteors, constantly igniting, travelling a short distance, and then expending themselves by combustion. They are so numerous and their movements are so eccentric as to resemble illuminated miniature flakes of snow during a violent snow-storm. These small meteors result from the combustion in the atmosphere of minute streams of compound hydrogen gas, which inflame as they are produced, and supply the light upon which the descending rays of light feed during their descent from their infantile source, till they impinge on, and are absorbed by, the earth's surface. For the information of the existence of these infinitesimal meteors I am indebted to the late Professor Maverly, who, for fifty years, was astronomer and natural philosopher at the observatory attached to the Royal Naval Academy at Gosport. He was one of the first to oppose my views, as contained in the paper I have been reading, but after six years of opposition he became a convert, and was the first to acknowledge himself as such in the public newspapers in the year 1857."

ANSWERS TO CORRESPONDENTS.

⁂ All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publishers, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. *Private* letters for the Editor must be so marked.

⁂ In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

F. J. Foster.—See various papers in vol. x. of Chemical News.

K. K.—A method of producing tetrachloride of carbon cheaply would, no doubt, be of great commercial value.

Alpha.—Mr. Gossage can give you the information. We know of no statistics later than those which will be found in the Report of the Committee of the House of Lords on the Alkali Works Bill. The Board of Trade Returns will give you the exports of soda regularly.

Received.—Trenham Reeks; E. Osborne; H. R.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Researches on the Volatile Hydrocarbons, *by* C. M. Warren.[*]

I. Hydrocarbons from Coal-tar Naphtha.—In presenting the results of a re-examination of a series of substances upon which so much labour has been already bestowed, it may confer an interest on the subject to state briefly some of the more important results and conclusions arrived at by previous investigators.

The discovery by Faraday in 1825 of benzole ("bicarburetted hydrogen") in the oil compressed from coal-gas rendered it highly probable, and, indeed, led this distinguished philosopher to suspect, that this substance might be found in coal-tar naphtha. His search for it, however, proved unsuccessful, it having been first detected by Hofmann in 1845. This chemist, however, did not attempt to isolate the body, and the bare fact of its presence appears to be all that was definitely known of the composition of coal-tar naphtha prior to 1849, in which year Mansfield published his elaborate and valuable research, being the first effort at a proximate analysis of this mixture which appears to have been attended with any considerable measure of success. It may be said that little has since been added to our knowledge of this subject. Notwithstanding the incompleteness of his separations of the hydrocarbons, the extent to which he carried them, with the limited means employed, is truly remarkable, and could not have been accomplished without an expenditure of labour and a degree of patient endurance which only those who have experienced the tediousness of such operations can appreciate.

Mansfield claimed to show that the light coal-tar naphtha is composed of a mixture of four distinct hydrocarbons, boiling within the range 80° to 175° C., and probably having the general formula CnHn − 6. The first of these, which he found to boil constant at 80°, was proved to be identical with benzole $C_{12}H_6$. The second, boiling about 113°, was determined, from certain reactions, to be identical with toluole, $C_{14}H_8$. The special study of this body was deferred, however, with the remark that it had not yet been isolated in a state of sufficient purity to claim an analysis. The third body, boiling about 140° to 145°, was said to present all the characteristics of cumole, $C_{18}H_{12}$; but this view was merely an expression of opinion in advance of anticipated results. Of the fourth body, boiling at about 170° to 175°, Mansfield remarks that it bears so strong a resemblance in odour and properties to cymole, $C_{20}H_{14}$, as to induce the belief that this substance is identical with the hydrocarbon existing in oil of cumin. It thus appears that of the four bodies benzole was the only one which Mansfield had studied in any detail; yet his conjectures as to the identity of the other bodies, thrown out by way of preliminary notices of results acknowledged to be incomplete, have been extensively quoted and generally received as established facts. In addition to the bodies already mentioned, Mansfield also discovered a body more volatile than benzole, having an alliaceous odour, and which he found to boil betwen 60° and 70°.

Ritthausen made a re-examination of the light coal tar naphtha, in order to obtain the hydrocarbons in a state of greater purity, and to prove the correctness of Mansfield's view of the composition of this naphtha. In regard to the results he obtained, he says they fully confirm those of Mansfield. Of the body which Mansfield thought identical with cymole, and of the oil more volatile than benzole, Ritthausen obtained quantities too small for investigation. In regard to the latter, however, he remarks that to Mansfield's account he can add "that its nitro-product quite resembles that of benzole, and hence that at all events it belongs to the series CnHn − 6, and perhaps has the formula $C_{10}H_4$." Ritthausen omitted to analyse and determine the vapour density of any one of the substances; he therefore adds nothing more than a confirmation of the results of Mansfield. He gives the boiling-point of benzole at 80°, of toluole at 109°, and of the so-called cumole at 130°—140°, which will be found to agree very nearly with my own determinations.

Church, in the following year, published a paper on the "Determination of Boiling-points in the Benzole Series." I cannot better present his results than by quoting the following table:—

Formula.	Boiling-point.	Difference.
Benzole, $C_{12}H_6 = C_6\ 3(C_2H_2)$	80°·8	
Toluole, $C_{14}H_8 = C_6\ 4(C_2H_2)$	103°·7	22°·9
Xylole, $C_{16}H_{10} = C_6\ 5(C_2H_2)$	126°·2	22°·5
Cumole, $C_{18}H_{12} = C_6\ 6(C_2H_2)$	148°·4	22°·2
Cymole, $C_{20}H_4 = C_6\ 7(C_2H_2)$	170°·7	22°·3

Church states that he obtained all of these bodies from coal naphtha, and also that he obtained benzole from benzoic acid, toluole from toluylic acid, xylole from wood spirit, cumole from cuminic acid, and cymole from oil of cumin; and that he has found the corresponding bodies from these different sources to be identical. It will be observed that Church claims to have discovered in coal tar a body boiling at 126°2, which he calls *xylole*, thus supplying from this source a fifth member of the benzole series; whereas Mansfield and Ritthausen found only four bodies within the range of temperature indicated by the table. It will also be observed that his determination of the boiling-point of toluole is much lower, and that of cumole much higher, than the corresponding determination of Mansfield and Ritthausen; thus giving room for a middle member between them, and preserving a remarkable uniformity of difference—viz., 22° and a fraction—between the boiling points of any two contiguous members, for the addition C_2H_2.

That the earlier investigators had found in coal-tar naphtha only the two lower members ($C_{12}H_6$ and $C_{14}H_8$) and the two upper members ($C_{18}H_{12}$ and $C_{20}H_{14}$) was always to me an anomaly which I could not reconcile with any plausible theory in regard to the formation of these bodies; and I was led, therefore, to question whether the middle member ($C_{16}H_{10}$) had not been overlooked in making the separations. The alleged discovery of this body in coal naphtha by Church, together with the uniformity of boiling-point difference which he presented, and the apparent care with which the research had been conducted, led me to regard his results as more reliable than any previously published. I remained under this conviction until I had discovered the boiling-point difference of 30° in other series of hydrocarbons, which led me to doubt the accuracy of Church's determinations, and to consider those of Mansfield and Ritthausen as probably more correct.

In the first paragraph of his memoir Church remarks that, "although doubts still remain as to the relations of these bodies to one another, yet their composition has been ascertained with certainty." It does not appear, however, that an analysis or vapour density of any one

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[*] Abridged from the Memoirs of the American Academy.

member of the series as obtained from coal-tar, except benzole, has ever been published. As indicated by the title of his paper, it appears to have been the design of Church to treat only of the boiling points of these bodies; yet finding that his preparations of toluole—prepared both from coal naphtha and toluylic acid—gave a boiling point differing considerably from observations previously published, he took occasion to make analyses of this substance, which he regards as "perfectly satisfactory;" but he omits to give the details and numerical results. As he undertook to correct the work of his predecessors, to do which fairly would seem to require the publication of these details and numerical results, their omission is to be regretted. I am prompted to these remarks from having been led to undertake the tedious task of making a re-examination of coal-tar naphtha, mainly on account of the disagreement between Church's determinations, which I have found to be mostly incorrect, and those which had been previously published.

In addition to the bodies mentioned in the foregoing table Church alludes to the discovery of two other bodies, boiling respectively at 97° and 112°. Subsequently, in a "Note on Parabenzole, a New Hydrocarbon from Coal Naphtha," he publishes the details of an investigation of the former of these two bodies, which he found to boil "*perfectly constant* at 97°5," and to be isomeric with benzole.

I think I shall be able to show in what follows:—

1. That coal-tar naphtha contains only four hydrocarbons within the range of 80° to 170°, as taught by Mansfield and confirmed by Ritthausen.

2. That the benzole series within that range of temperature is limited to four members, and, therefore, does not contain five, as generally supposed.

3. That these four members have the boiling-points 80°, 110°, 140°, and 170° respectively; and, consequently, that the boiling-point difference in this series for an elementary difference of C_2H_2 is 30° instead of 22° and a fraction.

4. That the body obtained from coal-tar naphtha is not identical with cumole from cuminic acid, as assumed by Mansfield, nor even isomeric with it; but that it has the formula which has been assigned to xylole, containing C_2H_2 less than that of cumole.

5. That the body obtained from coal-tar naphtha boiling at 170° is quite a different body from cymole from oil of cumin, these bodies differing from each other by C_2H_2.

6. That cumole from cuminic acid, and cymole from oil of cumin, do not even belong to the benzole series.

7. That the parabenzole of Church was in all probability only a mixture of benzole and toluole.

(To be continued.)

Formation of Nitrous Acid from Ammonia.—It is well known that ammonia is decomposed by permanganate of potash, and nitrogen evolved. It does not, however, appear to have been hitherto observed that a good deal of nitrous acid is formed at the same time. If the decolourised solution is filtered from the precipitated hydrated peroxide of manganese, and slowly evaporated to dryness, a mixture of carbonate and nitrite of potash is obtained. Abundant red fumes of nitrous acid will be evolved from the residue on the addition of an acid. W. —*Annal. der Chem. und Pharm.*, November, p. 256.

PHYSICAL SCIENCE.

Apparatus for the Detection of Explosive Gases in Mines.

The lamentable accidents which from time to time occur in coal mines, causing such great destruction of life and property, have engrossed the attention of scientific men ever since the results of the study of natural phenomena have been practically applied to every-day life. Numerous methods of illuminating the mines in such a manner as to prevent the ignition of the combustible gases, but at the same time producing sufficient light to enable the men to work in comfort, have been suggested and employed with varying success.

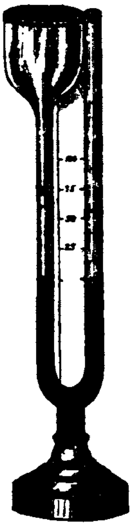
Next to preventing the accumulation and explosion of inflammable gas in the mines, the possibility of ascertaining with safety its presence is a matter of some importance, as it would enable the overseer to guard against incautious working in a dangerous part of the pit, and to prevent too great an accumulation of the explosive mixture by directing special attention to the ventilation. The process formerly employed by the miners to detect the presence of the inflammable gas, and which cannot be recommended as a safe one, was to bring a lighted candle into the suspected atmosphere, when the peculiar shape assumed by the candle flame gave the required information. This process cannot be too strongly reprehended, and it is probably the cause of many of the fearful accidents which have already taken place.

Another method, which is much more safe, but which is not unattended with danger, is to observe the flame of a Davy lamp. A careful viewer invariably reduces the flame of the Davy lamp to the smallest size that will emit white light before testing for gas, or, as he calls it, "trying a fiery place." When the atmosphere consists of a violently explosive mixture, one hears a peculiar and sharp click, and observes a rapid combustion of the gas within the wire gauze of the safety lamp; when the quantity of carburetted hydrogen is less, the flame of the lamp elongates; and when the quantity is very small, a peculiar lambent cap of a bluish colour is observed covering the flame of the lamp. These indications can only be learnt by experience in the mines, and when not properly attended to might give rise to disastrous results. Should the atmosphere be explosive, the viewer or fireman lowers his lamp very slowly and cautiously until it has passed out of the explosive mixture, which usually occupies the upper part of the gallery of a mine, and travels in that position, notwithstanding the law of diffusion. There are many well-authenticated cases of explosions through the gauze of the Davy lamp in a quiet atmosphere, and where the lamps after the explosions have been ascertained to be in good order.

A very ingenious instrument has recently been devised for the detection and quantitative estimation of the explosive gases by Mr. G. F. Ansell, of the Royal Mint. The instrument, which may be constructed in several different forms, is based upon the well-known law in accordance with which gases gradually mix with one another through porous septa, and even through some materials which do not appear to possess any interstices through which the gases might pass.

If a tube blown out into a cup at one end (Fig. 1), and bent in the form of the letter U be filled with mercury, so that the mercury stands in the cup, and the cup closed by a piece of porous tile cemented on by a resinous varnish, a

FIG. 1.



very serviceable indicator is obtained. On bringing this instrument into an atmosphere containing a gas differing from that contained within the cup, perceptible diffusion takes place through the unglazed earthenware. If the cup be filled with air and the apparatus introduced into an atmosphere of hydrogen, the hydrogen will pass into the cup more rapidly than the air will pass out, according to the well-known law that "gases diffuse into one another in the inverse proportion of the square roots of their specific gravities." The specific gravity of hydrogen being 1, that of air is 14·4. As the square root of 14·4 is 3·8, for every 1 part of air which diffuses out of the cup 3·8 parts of hydrogen will pass in through the porous tile. Thus the pressure on the mercury within the closed limb will exceed that on the liquid in the open limb, and a corresponding elevation of the mercury in the open limb will result. When the maximum effect has been produced, the pressure within the cup will gradually force the gas through the porous diaphragm until the mercury stands level in both limbs. At this point the gases within and without the apparatus possess the same composition, but any change of proportions in the external atmosphere is immediately indicated by the level of the mercury. If the instrument be removed into the air the hydrogen within will immediately diffuse outward, and a rise of the mercury in the closed limb will result.

If the apparatus containing air be placed in an atmosphere of a gas of greater density than the air—as, for instance, carbonic acid, diffusion will take place, but the converse phenomena will be observed. The specific gravities of air and carbonic acid being in the proportions of 14·4 to 22, the diffusion will take place in the ratio of 4·7 to 3·8—*i.e.*, for every 4·7 volumes of air which pass outwards, 3·8 of carbonic acid will pass inwards, so that the pressure on the mercury in the open limb will exceed that in the closed limb, and the mercury in the latter will rise; the alteration of level obviously being less than in the previous case, in which hydrogen was without the diaphragm. Of course, the theoretical elevation and depression of the mercury can in no case be observed, for during the whole time that diffusion is going on effusion takes place in consequence of the increased or diminished pressure of the apparatus. Mr. Ansell has constructed several pieces of apparatus on this principle. One (Fig. 1) consists simply of the U-tube with a scale graduated so as to indicate the percentage of mine gas present. In another form of the apparatus (Fig. 2) *a* is a piece of biscuit-ware cemented to a glass vessel (*b*), which at its lower end communicates with a U-tube containing mercury, on which, as it rises in the open limb, there floats a small weight, to which is fastened a cord passing over a pulley, and counterbalanced on the opposite side, the rise and fall of the mercury causing the pulley to revolve and to indicate the alteration of pressure by the movement of a pointer on a dial (*c*). This is for use *only* on occasion of a sudden irruption of fire-damp.

Figure 3 is a section of a porous battery cell which is used instead of the glass vessel (*b*) in figure 2, but it does not give better results than those attained by the tile (*a*).

FIG. 2.

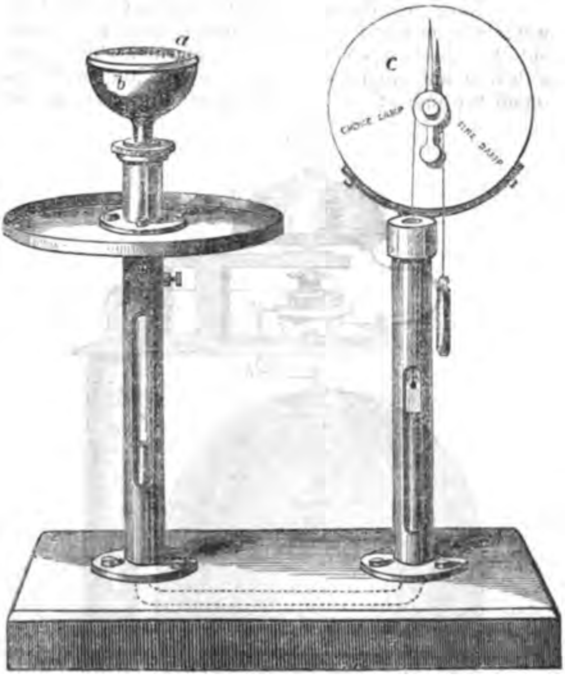


FIG. 3.

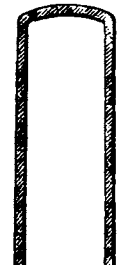
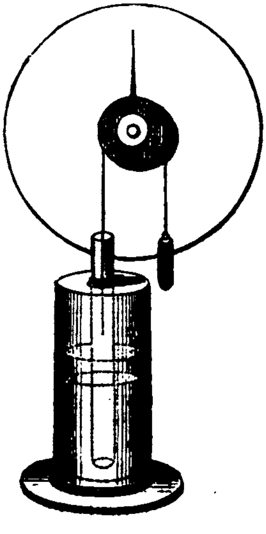


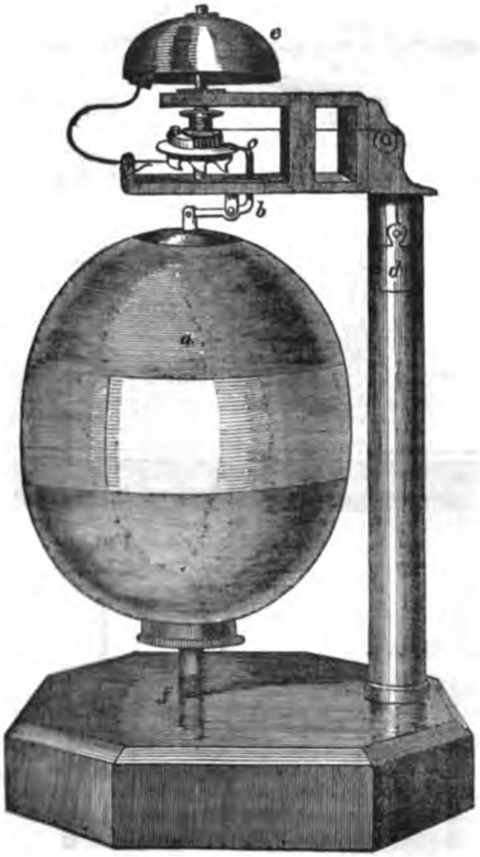
FIG. 4.



Another apparatus (Fig. 4) on the same principle has been constructed by enclosing a U-tube with a bulb containing mercury in an inverted porous battery cell. The edge of the cell is firmly cemented on to a piece of wood; a small metal weight floats on the surface of the mercury in the tube, and is attached to a piece of string, which passes over a pulley, and, by the alteration of the level of the mercury in the tube, moves an index, as in the previous form of the apparatus. On bringing the porous cell into a gas containing carburetted hydrogen, some of the gas diffuses into the cell, causing a rise of the mercury in the glass tube and a corresponding movement of the index.

All these modifications of the apparatus must be watched in order to obtain any information from them; but Mr. Ansell has constructed an alarum, which rings a bell if any quantity of gas SLOWLY ACCUMULATES round the indicator. The instrument Fig. 5 consists of one of the thin india-rubber balloons (*a*) so well known at the present time. One of these is placed on a piece of brass, which can be raised and lowered by a screw. The upper end of the balloon presses against a lever (*b*), which, when raised, liberates a train of clock-work at (*o*), and rings a bell (*e*). To increase the movement of the lever a band of linen is bound around the equator of the balloon in order to prevent lateral expansion and to concentrate all increase of volume in a polar direction. If this apparatus be placed in the gallery of a mine, the presence of or an increase in the quantity of mine gas will cause the expansion of the balloon, and consequent ringing of the alarum. The balloon remains in its expanded state until the composition of the atmosphere is altered.

FIG. 5.



Mr. Ansell has devised an instrument which for elegance and utility far surpasses all the others, as it admits of the determination of the quantity of mine gas present in a mixture. The apparatus consists of a small aneroid barometer, the case of which is made perfectly air-tight, but the interior of which may be placed in communication with the external air by opening a small screw fastened on the handle. The brass back of the barometer is replaced by a thin plate of porous earthenware, and may be covered with a brass cap or back placed on a hinge like that of a watch. Under ordinary circumstances the screw remains open, but when it is required to test the gas in a mine, the screw is closed and the cap removed from the porous plate. Immediately diffusion takes place, and the pressure increasing, causes a corresponding movement of the hand of the barometer. In about forty-five seconds the maximum effect is produced, when the position of the hand indicates by means of a vernier the percentage of mine gas present. If the apparatus be left for a sufficient time, the internal pressure forces the excess of gas through the porous plate, and the needle returns to the zero point. On subsequently allowing diffusion to take place into pure air, the index retrogrades to the same extent (if the mixture does not contain more than 10 per cent. of mine gas or "fire-damp") to which it had previously advanced. This apparatus, which is not larger than an old-fashioned watch, will undoubtedly prove of great service to the mine overseer, as it can at any time be carried into the gallery of a mine. The percentage of gas is determined in less than a minute.

As is to be expected, the motion of the train of trucks running into, or out from the pit, causes a variation of the pressure, therefore it is necessary to avoid such intervals in making observations by the instrument last described. It is well to mention that temperature need not be taken into account, for it is found that the temperature of the same part of a mine does not vary from year's end to year's end. The instruments denoted by figures 2, 4, and 5 are connected with telegraph arrangements, and these as well as the aneroid barometer have given full satisfaction to practical miners in several mines where they have been tried.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, December 7.

Dr. WARREN DE LA RUE, *F.R.S., Vice-President, in the Chair.*

THE minutes of the previous meeting were read and confirmed, and the several donations to the Society's library were enumerated and acknowledged. These included the Annual Report for 1864 of the Danish Academy of Sciences, the *Transactions* of the Royal Society of Edinburgh, the *Proceedings* of the British Pharmaceutical Conference (Birmingham, 1865), and copies of Dr. A. W. Hofmann's "Introduction to Modern Chemistry," besides several other works and periodicals of scientific interest. The candidates proposed for admission into the Society were, for the first time,—Mr. Thomas B. Redwood, 19, Montague Street, Russell Square; Mr. John Conroy, Christ Church, Oxford; Mr. Robert Henry Smith, Rodney Street, Pentonville; and Mr. James Speir, of Messrs. Barclay and Speir, chemical manufacturers, Newcastle-upon-Tyne. For the second time were read the names of John Percy, M.D., F.R.S., lecturer on metallurgy in the Royal School of Mines; Mr. Ernest T. Chapman, George Street, Portman Square; Mr. Charles N. Ellis, Bow Common; and Mr. Thomas Ward, Bolton. The names of the following gentlemen were read for the third time, and they were duly elected by ballot,—viz., John Hunter, M.A., Queen's College, Belfast; Mr. Theodore Maxwell;

Mr. W. J. Barnes, Buckhurst Hill, Essex; Mr. W. E. Bickerdike, Dalton Square, Lancaster; Mr. Richard Fitz Hugh, Nottingham; Mr. Alfred Gardiner Brown, M.R.C.S., Trinity Square, Southwark; and Dr. William B. Ritchie, Belfast.

A communication entitled "*Notes on Pyrophosphodiamic Acid*" was presented by Dr. J. H. GLADSTONE, F.R.S. The author stated that it had been his original intention to address the Society upon the subject of a newer product with the investigation of which he had been lately engaged. but inasmuch as the analyses of pyrophosphotriamic acid and certain of its compounds were not yet completed, the speaker preferred for the present to limit himself to an account of some new modes of preparation, and a further description of the properties of pyrophosphodiamic acid. This substance, originally called deutazophosphoric acid by Dr. Gladstone, was more accurately described in a paper by the late Mr. Holmes and himself, which was read before the Society about eighteen months ago. Its formula is, — $P_2N_2H_6O_5$, in which two atoms of the hydrogen are replaceable by metals. Three methods of preparing it have been previously described—1st, by decomposing chlorophosphide of nitrogen by an alkali; 2nd, by saturating phosphoric anhydride with dry ammoniacal gas; and 3rd, by saturating oxychloride of phosphorus with the same at a low temperature, and dissolving in water. The two stages of the reaction were explained thus:—

$$PCl_3O + 2NH_3 = PNH_2Cl_2O + NH_4Cl.$$
$$2(PNH_2Cl_2O) + 3H_2O = P_2N_2H_6O_5 + 4HCl.$$

The two last methods may be modified by using the very strongest solution of ammonia instead of the gas. There are also other methods of producing this acid—4th, by throwing pieces of pentachloride of phosphorus into the *liq. ammon. fort.*, when some pyrophosphotriamate of ammonium is at the same time formed; but the main result accords with the following equation:—

$$2PCl_5 + 12NH_3 + 5H_2O = P_2N_2H_6O_5 + 10NH_4Cl.$$

5th, by exposing oxychloride of phosphorus to ammonia gas at 100° C., when *four* equivalents of the latter are absorbed (instead of *two*, as described under the third method), and submitting the product to the subsequent action of water—

$$PCl_3O + 4NH_3 = PN_2H_4ClO + 2NH_4Cl.$$
$$2(PN_2H_4ClO) + 3H_2O = P_2N_2H_6O_5 + 2NH_4Cl.$$

6th, by performing a similar experiment at a much higher temperature, the same amount of ammonia yields different products, among them one which is insoluble in water, but when heated with sulphuric acid dissolves with the formation of pyrophosphodiamic acid; 7th, the same compound is formed when pyrophosphotriamic acid is heated in a similar manner with sulphuric acid—

$$P_2N_3H_7O_4 + H_2SO_4 + H_2O = P_2N_2H_6O_5 + NH_4,HSO_4.$$

Or, 8th, when the same acid is heated alone until it begins to suffer decomposition; 9th, Gerhardt's phosphamide, when heated with sulphuric acid, also yields pyrophosphodiamic acid, thus—

$$2(PN_2H_2O) + H_2SO_4 + 3H_2O = P_2N_2H_6O_5 + (NH_4)_2SO_4.$$

The fourth method of preparation was exhibited by Dr. Gladstone, and the characteristic reaction by which the pyrophosphodiamic acid could be identified was shown experimentally. [The pentachloride of phosphorus acted rather violently upon the aqueous ammonia; the solution was filtered, and then strongly acidified with sulphuric acid (one of oil of vitriol to two parts of water); a few drops of ferric chloride were added, and the solution heated, when a white flocculent precipitate appeared.] This ferric compound could be easily distinguished from the ordinary phosphate of iron, which it much resembled in physical aspect, by its solubility in ammonia and production in strongly acid solutions. The pyrophosphodiamates of silver, barium, calcium, zinc, copper, nickel, etc., have been examined by the author; they are for the most part flocculent precipitates readily soluble in acids, ammonia, and even in the aqueous solutions of ammoniacal salts. The mercuric chloride gave no precipitate, neither did solutions of aluminium, chromium, and magnesium. The pyrophosphotriamic acid, of which the formula is given above, $P_2N_3H_7O_4$, was stated to be insoluble in water, but readily soluble in warm acids.

The CHAIRMAN, after moving a vote of thanks, inquired of Dr. Gladstone the grounds upon which he used the prefix "pyro" in connexion with the diamic and triamic acids, since these bodies were not produced by fire?

Dr. GLADSTONE replied that the bodies in question were framed upon the type of pyrophosphoric acid.

Dr. FRANKLAND would rather have confined the use of the term "pyro" to tetra-basic acids.

Dr. ODLING entertained a different opinion, and preferred to have regard to type rather than to basicity, thus:

$$\begin{array}{ll} \text{Pyrophosphoric acid} & \left\{ \begin{array}{l} P_2H_4O_7. \\ \text{or } (P_2O_3)(HO)_4. \end{array} \right. \\ \text{Pyrophosphodiamic acid} & \quad (P_2O_3)(HO)_2(NH_2)_2. \end{array}$$

The mono-acids would be respectively—

$$(PO)(HO)_3.\ \text{and}\ (PO)(HO)_2(NH_2).$$

Or, starting from the oxychloride of phosphorus, we should look for the following amides:—

$$POCl_3$$
$$POCl_2(NH_2)$$
$$POCl\,(NH_2)_2$$
$$PO(NH_2)_3.$$

Dr. GLADSTONE said he could not give a reason for the change from one type into another; he had never been able to prepare the body last named in the series, the triamide.

Dr. HUGO MÜLLER said he could avail himself of the opportunity of making a few remarks on the subject of "*Phenylo-Phosphoric Acid.*" Some years back, when engaged with some experiments on phenyl-compounds, he examined the deportment of phenylic alcohol with phosphoric anhydride and chloride of zinc, with the view of obtaining by means of these agents the hydrocarbon phenylene. He found, however, that phenylic alcohol was not acted upon as expected; and whilst chloride of zinc showed no action whatever, the influence of the phosphoric anhydride was confined to the formation of phenylophosphoric acid. On mixing crystallised phenylic alcohol with phosphoric acid, a pasty mass is formed with elevation of temperature, which, after the application of a further heat, becomes gradually homogeneous. On raising the temperature, some of the phenylic alcohol distils over unaltered, and the residue, on being dissolved in water and treated with carbonate of barium, yields phosphate of barium and a solution of phenylophosphate of barium. The metal having been separated by sulphuric acid, the aqueous solution, on being carefully evaporated, yields the phenylophosphoric acid in the form of a heavy oily liquid, which separates from the concentrated solution. The phenylophosphoric acid forms well-crystallised salts, which show a considerable degree of stability. The potassium and ammonium compounds are very soluble in water, and exist in the form of fibrous crystals. The magnesium salt is readily soluble and indistinctly crystalline. The barium salt is less soluble than the former, and separates from its concentrated solutions in the shape of beautiful long silky crystals resembling caffein. On mixing a solution of phenylophosphate of barium with acetate of lead, a white precipitate is obtained, which, after a short time, becomes converted into a mass of silky crystals, or in more dilute solutions the lead salt separates gradually, or upon evaporation takes the form of beautiful crystallisations, which are very similar to the barium compound. Nitrate of silver gives with the free acid, as well as with the solution of the barium salt, a flocculent white precipitate, which soon becomes changed in colour to yellow and brown. Solutions of copper, nickel, cobalt, and zinc do not give precipitates in the cold, but when heated produce flocculent precipitates, which re-dissolve on cooling. All the salts of phenylo-phosphoric acid exhibit the highest degree of solubility at a temperature between 40° and 60° C., and show in this respect a great resemblance to the salts of the corresponding ethylo-phosphoric acid. [Specimens of the lead and barium salts were exhibited by Dr. Müller.] The author further stated that the barium salt appeared to be the only one which was anhydrous, and its organic analysis by combustion presented some difficulties; on this account the constitution of the acid had not yet been accurately determined. The body was altogether different from the phenylic phosphate of Professor Williamson.

Professor A. H. CHURCH made a statement respecting the properties of ethylo-phosphoric acid, and referred particularly to the fact of its salts being less soluble in boiling water than at a lower temperature.

A vote of thanks to Dr. Müller was proposed, and the CHAIRMAN, previous to the adjournment of the meeting, took occasion to announce that the committee appointed by the British Association for the special consideration of weights and measures had invited the co-operation of the Chemical Society in suggesting a suitable metal or material from which to manufacture the standards of the new metrical system, the use of which had already been legalised in England. The committee would probably attend the next meeting of the Society, on the 21st December, and the Fellows were therefore requested to give the subject their best attention in the interim.

SOCIETY OF ARTS.

CANTOR LECTURES.

"On some of the most important Chemical Discoveries made within the last Two Years."

By Dr. F. CRACE CALVERT, *F.R.S., F.C.S.*

LECTURE 3.

Tuesday, April 18, 1865.

(Continued from page 274.)

Although it is impossible in a lecture like this to attempt to give a correct idea of all the phenomena connected with respiration, and all the data which bear upon that important function of life, I may be permitted to give a few data, which will enable you, I hope, to have a general idea of the present theory of respiration. Man inspires about thirty times a minute, and at each inspiration there rushes into his lungs about a pint and a-half of air, which penetrates into the myriads of cells composing the lungs, and comes in contact there with the blood, as above stated, which it converts from venous into arterial. At the same time a certain quantity of air, or oxygen, is dissolved, which not only affects the above conversion, but displaces from the venous blood a certain quantity of carbonic acid which it contains. Thus it is found by experience that one hundred parts of air that man inspires, contains, in round numbers, twenty-one parts of oxygen; whilst the gases he expires are represented by sixteen parts of oxygen, four parts of carbonic acid, and one part of oxygen which has been transformed into water, thus making up again the twenty-one parts of gaseous matter in the 100 which he inspired. But the production of this carbonic acid is chiefly caused by the action of the oxygen dissolved in the arterial blood during its passage and contact with the animal tissues and the glycogen existing in the capillary vessels; for it is there that we observe the change of blood from arterial to venous, the conversion from venous into arterial being, as above stated, in the lungs.

Several theories have been promulgated by chemists and physiologists as to how the oxygen acts to convert venous into arterial blood. Liebig assumed that the blood dissolved oxygen as water dissolves that gas and others; and he explains the greater solubility of oxygen in the blood than in water, by asserting, and that on experiment, that phosphate of soda, which exists in blood, facilitates the solution of oxygen in that fluid. Dumas states that it is the iron which exists as one of the elements of the colouring matter of blood, called, as above stated, hematosine, which fixes the oxygen in the arterial blood, and yields it again to various organic matters, either those originating from glycogen or those resulting from the wear and tear of life, and which may be considered as refuse matters which require to be removed from the system. The iron thus becomes deprived of its oxygen, and is ready to reabsorb a fresh quantity when it comes again in contact with the oxygen of the atmosphere in the lungs.

These theories do not appear, so far as I am aware, to have received the general sanction of physiologists; and I therefore deem it to be my duty to call your attention to some interesting optical researches, due to that eminent *savant*, Professor Stokes, of Cambridge. That gentleman has observed that when a small quantity of blood is mixed with water, and the whole poured into a small tube, and this, in its turn, placed in such a position as to allow a ray of light to pass through the blood solution, and that then the ray of light is made to pass through a prism, he finds that the spectrum so produced has undergone certain modifications, which consists in the fact that certain tints or colours of the spectrum have disappeared; and he, moreover, observes that these "bands of absorption," as he calls them, are characteristic, for they differ according as the blood placed with the water in the tube is arterial or venous, and so delicate is this mode of investigation that he can discern the slightest modifications which blood undergoes. In fact, I may state *en passant* that he has applied this mode of investigation to distinguish vegetable and animal matters, which, though having a great similitude, become distinguishable by the simple mode of applying optics to their investigation.

Coming back to blood, I may state that the researches of Professor Stokes on the action of oxidising agents on blood, have thrown much light on the phenomena connected with the conversion of venous into arterial blood. He has remarked that if arterial blood is shaken with an alkaline solution of sulphate of protoxide of iron, or protochloride of tin, it assumes the dark colour of venous blood, and that if he then agitates the same dark purple blood with air, it absorbs the oxygen, becomes oxidised, and, therefore, is converted into red arterial blood.

The facts, joined to many more which can be found in the *Proceedings* of the Royal Society for 1864, have led Professor Stokes to the conclusion that the colouring matter of blood is the real carrier of oxygen; that it absorbs oxygen and becomes scarlet; and that it yields its oxygen to organic substances during its circulation through the system, and becomes purple or venous blood. He has given to the colouring matter of blood the name of *cruorine*, and calls it purple or scarlet cruorine either as it exists in the veins or arteries.

I think it is useless to repeat here many facts connected with this subject, and which I brought to your notice in my last year's lectures.

Urine.—Having also dwelt in my last course at some length on the principal elements contained in this important secretion, I deem it my duty merely to call your attention to one or two facts of some immediate importance which have been published since then. One of these is due to Dr. Marcet, who has found in that secretion a substance which, until his investigations, had been unnoticed by chemists. I mean an amorphous or non-crystallisable acid, which he calls colloidic acid, from the circumstance that it cannot pass or diffuse itself through animal membranes. I may here mention that substances in general, according to the theory of Mr. Thomas Graham, the Master of the Mint, may be divided into two classes, namely—those which crystallise, and which he calls crystalloids, and those which do not diffuse, and which he calls colloids, from the French word *colle*, or glue. M. E. Morin has also published some elaborate researches on the relative proportions of oxygen and carbonic acid in urine, and the following table will show you the influence which exercise has upon the combustion of organic matter through the oxygen conveyed in the blood by the cruorine of Professor Stokes, converting the organic matter into carbonic acid, for this gas is found, as you will see, more abundantly in the urine of man when in a state of activity than when in a state of repose:—

GASES IN THE SECRETION OF THE KIDNEYS.

Quantities of Gases in 100 parts of Urine.	Composition of the Gases.	Activity.	Repose.
From 2·62 to 3·61	Carbonic acid	73·56	62·93
	Oxygen	1·65	1·89
	Nitrogen	24·79	35·18
		100·00	100·00

I wish now to invite your consideration for a few minutes to some interesting facts which have lately been published by Dr. H. Bence Jones, on the extraordinarily rapid absorption of certain substances into the animal system. He has observed that substances, such as lithium and rubidium, will be found to have passed into the whole of the human system three or four hours after they have been administered, either as medicines or as a matter of experiment. In fact, he has found that the absorption is so complete that he has been able to detect their presence in the non-vascular textures of the body; and what enhances the interest of his researches is, that he employed, as a means of analysis, for the detection of these substances, the property which they have of communicating colour to flame, and therefore applied to their detection the spectroscope of Bunsen and Kirchhoff.

Whilst on the subject of the rapidity of the absorption of matter by the body, I may state that a French physiologist has observed that certain saline matters, such as iodide of potassium, nitrate of potash, or acetate of morphia, will pass in a few seconds through the whole of the system. Thus he was able to detect the presence of iodide of potassium in the urine three minutes after it had been taken by the mouth. But certainly one of the most curious instances published of late respecting the absorption of organic matters in the system is that related by Dr. Letheby, and which tends to prove the correctness of statements which have been published in former times, that certain chemists or persons had a secret of producing poisons, the action of which only became manifest a long period after they had been administered. Thus, Dr. Letheby states, in a paper which you will find in the *Proceedings* of the Royal Society, and which contains some of the facts which he gave in evidence at a coroner's inquest in London, that the death of a person ensued twelve months after he had taken the substance which caused death. A man engaged in a large chemical works in London had inspired, during his labours, a comparatively small quantity of a substance called nitro-benzine (now sold under the name of oil of bitter almonds, and used in large quantities for perfumery, and also for giving taste to various culinary preparations), and that this substance had gradually become converted into aniline (a substance now extensively used to produce colours, and also procurable from coal tar), and had been the cause of the death of the man.

I would invite all lovers of animal physiology to read with attention the researches of M. Claude Bernard on the physiological action of curarine, or the active principle of the curare, or the poisonous mixture used by the Indians at Madagascar, and on the banks of the river Oronoco. These researches will be found in several articles published by him in the *Revue des Deux Mondes*, 1864; and, to excite your interest in reading the articles, I may state on his authority that the death which ensues by the injection into the blood of a trace of this poison may be considered as the most curious and distressing that can be conceived, and he further states that the physiological phenomena which are witnessed during the process of death may lead to the most beneficial application of the substance as a therapeutic agent.

Although time is pressing, I cannot part from you this evening without calling your attention to the fact that every day we are realising the cherished ideas of the alchemist, and of the medical men of the fifteenth and sixteenth centuries, who laboured, the one to extract from substances what they called the quintessence of them, and the other to apply what they supposed then to be such quintessences. From the imperfect state of science, chemistry included, at that time, they were unable to carry out what they conceived to be essential to arrive at a better and more enlightened treatment of disease. They perfectly felt that the extracts or infusions of the plants they had at their command had not a defined action in their treatment. All men of science know with what enthusiastic perseverance Paracelsus advocated the employment of quintessences; and, although in his enthusiastic mind he went so far as to pretend that he carried in the head of his cane the elixir of life, there is no doubt that he and his disciples left a germ, which has gradually grown to be a plant, and that the chemistry of the present day is gradually succeeding in extracting from plants their active principles. Although medical men were convinced of the utility of employing the active principles existing in plants, as quinine, cinchonine (from cinchona bark), morphine (from opium), &c., still we had not a correct idea of the various actions which these diverse alkaloids exerted on the system. We are, therefore, much indebted to M. Claude Bernard for his admirable researches on the therapeutic action of the alkaloids of opium; and owing to his extensive physiological knowledge, as well as his perfect mode of carrying out his experiments, he has proved that we can class the action of the alkaloids of opium under three heads, as shown by the following table:—

THE ALKALOIDS OF OPIUM.

Soporific.	Convulsive.	Toxic.
Narceia.	Thebaia.	Thebaia.
Morphia.	Papaverine.	Codeia.
Codeia.	Narcotine.	Papaverine.
	Codeia.	Narceia.
Not Soporific.	Morphia.	Morphia.
Narcotine.	Narceia.	Narcotine.
Thebaia.		
Papaverine.		

These researches thoroughly prove the correctness of Paracelsus's views, showing that in the employment of opium due consideration should be given to the fact that in the opium there are various agents acting in a defined manner upon the organs of the patient.

I cannot conclude this lecture without drawing your attention to several interesting papers which have been published by Dr. Polli, of Milan; Davanne, Royer, and Le Maire, of Paris, tending to prove that the source of many diseases, especially those of a contagious nature, may be due to the sporules or germs of certain animal or vegetable ferments which penetrate with the air into the system, coming in contact, as it does, with the blood in the lungs of man. The difference between the views of these gentlemen and those who preceded them is that formerly these statements were merely theoretical, whereas these gentlemen, by the aid of the powerful microscopic instruments now brought into use, have been able to trace the presence of vegetables or animals in blood either of animals or man affected with certain classes of disease. I may cite as an example the discovery in the blood of the carbuncle, of the presence of vibrios and bacteria. (Royer and Davanne.) These facts explain why these gentlemen have applied with such success the most powerful antiseptic agent yet known in the treatment of that disease—namely, carbolic acid, and there is no doubt in my mind that the spread of either scarlet fever, typhoid fever, cholera, or any diseases arising from the decay of blood or its decomposition, is brought about by the introduction into the blood of certain ferments which completely alter the nature of that fluid, as in the case of the carbuncle and similar diseases. If these views are correct—and I think I am justified in saying that they have the support at the present day of some of the most eminent men on the Continent—the employment of carbolic acid, either to prevent the spread of, if not to cure, these diseases, deserves the attention of the medical world.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, November 14th, 1865.

R. Angus Smith, *Ph.D., F.R.S., &c., President, in the Chair.*

Mr. Charles Bailey and Mr. Thomas Barker, M.A., Professor of Mathematics, Owen's College, were elected Ordinary Members of the Society.

The following extract of a letter from Thomas Ainsworth, Esq., of Cleator, near Whitehaven, Corresponding Member of the Society, accompanying a copy of his meteorological observations for October, was read by Mr. Baxendell:—

"The great peculiarity of the season has been the very heavy dews we have had—great luxuriance of pasture nourished by dews and not by rain. I have drawn Professor Simmond's attention to this, as being a predisposing cause of the present cattle disease. Not that it really engenders the malady, but predisposes the animal to take this peculiar type of disease—my own experience from the readings of my instruments some twelve or fourteen years ago having shown that disease of the same type attacked my cattle and destroyed them, and each time when the high temperature of the day and the low temperature of night gave us such heavy dews as to render the herbage quite indigestible."

Mr. Baxendell considered it very probable that cattle would be injuriously affected by feeding on herbage which had not been well washed by occasional showers of rain. Dew had little or no washing effect, and it could not remove the impurities which were deposited upon the leaves of plants during long periods of dry weather. The cattle plague is said to have had its origin in Central Asia, and in this region there is very little rain, and the daily range of temperature is very great. The herbage is therefore seldom well washed, and moreover the cattle that feed upon it are exposed to frequent and violent changes of temperature. We have no report of any cattle plague breaking out among the herds on the pampas of South America, where rain falls more abundantly and the changes of temperature are much less violent.

The President said that the idea of deriving the cattle plague or any similar epidemic from the organic matter brought down by dew was at least in harmony with much that we had learnt. The dews and fogs of evening over certain lands were known to produce colds, agues, or fevers which could be avoided by rising to a certain height from the ground. There seems little doubt that the moisture in such cases is not the cause of disease, but only the means of conveyance. These diseases were produced by breathing the impure air. We know less of the effect when the matter is condensed and conveyed into the [illegible], but the effect of impure water made this use of it also suspicious. He was not aware that it could be shown that in aggravated cases another class of disease might not be produced. In Manchester we can see the accumulation of matter taking place in the fog to such an extent that it lies like a cap over the whole town, and so increases that every sense is affected, whilst the lungs and eyes suffer severely. The matter in solution in this case is not putrefactive, although injurious, or it would probably sweep us off instantly. Probably no accumulation of putrefactive matter equal in amount ever occurred in the natural atmosphere. It illustrates, however, the mode by which the emanations of the soil are collected in the atmosphere and presented in a concentrated form for us to breathe. He had for many weeks collected dew on a grass lawn in a garden, and from it had obtained organic matters unquestionably collected from surrounding objects, as it was known on one occasion to smell of flowers. If this entered into putrefaction it would of course be unwholesome, but what kind of disturbance of health it would cause it must be for others to find. The evening air of a rainy country like this is less dangerous than that of some other climates where there is more both evaporated and condensed, and neither wind nor rain to remove it. Notwithstanding this, he believed that more than the dew was required, especially in northern climes.

The President also said, that when sitting in a railway carriage with his friend, Mr. James Young, of Bathgate, that gentleman observed that the particles of dust which floated in the air seemed to shine with a metallic lustre. Dr. S. immediately collected some, and found that the larger class were in reality rolled plates of iron which seemed to have been heavily pressed and torn up from the surface. Another and smaller class were less brilliant, and when looked at with a considerable power showed many inequalities of surface which would be interesting to study. Probably these were the particles which were not torn up, but rubbed off. The dust enters the mouth and lungs, and has to be taken as one of the evils of railway travelling, although we do not know that these small particles are worse than those of sand. At any rate, it is clear that some kinds of iron will wear down more readily than others, and we ought to have that which will wear down least. By observing what takes place in the carriages on a dusty day, every man may to some extent compare the iron of different railways. Those which give off the largest pieces in greatest quantities are to that extent the worst, as regards health.

A paper was read entitled "*An Attempt to Refer some Phenomena Attending the Emission of Light to Mechanical Principles,*" by R. B. Clifton, M.A., Professor of Natural Philosophy in Owen's College.

The author attempted to shew, by analogical arguments, that it is possible to give some account of certain phenomena attending the emission of light, by assuming principles closely resembling, if not identical with, those adopted by Professor Clausius in his well-known paper on "*The Nature of the Motion which we call Heat.*"[*]

Matter is assumed in all cases to have its atoms grouped together into molecules, an assumption which seems necessary when the different allotropic states of certain substances are considered.

These molecules are assumed to be in motion, and also the atoms to be vibrating in the molecules; for, whatever may be the laws of the forces which bind together the atoms in the molecules, it is impossible to imagine the molecules to be in motion, and to be subject to mutual actions, without causing motion of the component atoms.

In solids and liquids the molecules are supposed to remain continually within the spheres of action of neighbouring molecules, so that the internal motion in a molecule is never due to the undisturbed action of the interatomic forces; the only difference between solids and liquids being that in the former the same molecules are

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[*] *Phil. Mag.*, vol. xiv., for 1857.

constantly neighbours, while in the latter a molecule may completely change its place in the liquid, and also that in liquids a molecule may perform complete rotations round axes through its centre of gravity, while in solids this is not generally possible.

In a perfect gas a molecule is supposed to be under the action of other molecules, only for a portion of time indefinitely small with respect to the whole time of motion, and its centre of gravity describes a polygonal path, only changing its direction of motion upon the near approach of the molecule to another molecule, or to a containing vessel, which may be considered as equivalent to an impact.

In an imperfect gas a molecule is supposed to be under the action of other molecules during a finite portion of the whole time of motion, this portion increasing as the gas approaches its state of saturation.

Between the molecules of a body, and the atoms of a molecule, the luminiferous ether is supposed to exist.

The vibrations in the ether which constitute radiant heat and light, are considered due to the vibrations of the atoms in the molecule, and not to the motion of the molecule as a whole; the latter bearing some such relation to the ether as a bell or a stretched string does to the air, the internal vibrations only in the two cases causing the vibrations in the surrounding media, which give rise respectively to light and sound.

It appears obvious that as the motion of a molecule of a body as a whole increases—that is, as the temperature rises, the internal motion in the molecule also increases, considering that the action of one molecule upon another must be due to the mutual action of atoms, or to the interatomic forces, it seems probable that the internal *vis viva* in a molecule, to which the light is due, is proportional to the *vis viva* of the molecule as a whole, to which heat is to be referred. Thus, as the temperature of a body rises, the internal *vis viva* in the molecules increases, and the *vis viva* communicated to the ether also increases; hence the intensity of the vibration in the ether increases, and at the same time the period of vibration diminishes, or waves of shorter length are continually produced with increasing intensity.

Hence, as the temperature of a body rises, radiant heat is given off, the intensity corresponding to a given wave length constantly increasing, at last then vibrations in the ether, with wave lengths corresponding to the extreme red of the spectrum, will be caused with sufficient intensity to be visible, and thus the body will begin at first to glow with red light; as the temperature still rises, and vibrations of shorter and shorter wave lengths become of visible intensity, the light emitted will gradually change from red to white.

From Draper's law that all bodies become incandescent simultaneously, as well as from other considerations, it seems probable that in all bodies the internal *vis viva* in the molecules bears the same ratio to the *vis viva* of the molecule as a whole.

In solid and liquid bodies, the molecules being constantly under their mutual actions, and these actions being subject to constant change from the varying relative positions of the molecules, the atoms cannot assume any definite periods of vibration, but are constantly changing the time of vibration; hence the vibrations in the ether will be constantly, and with extreme rapidity, changing their periods. This change having apparently no limit, and the effect upon the eye continuing for a finite time, light of all wave lengths will appear to be given off simultaneously by such bodies when the temperature is sufficiently high; in other words, incandescent solids and liquids will appear to give off white light, which when analysed by a prism will yield a continuous spectrum.

In the case of an incandescent gas or vapour sufficiently removed from a state of saturation to be considered perfect, the atoms will be left to vibrate under the action of the interatomic forces only, and will thus assume periods of vibration all included in a certain set; these vibrations will consequently cause vibrations in the ether corresponding only to certain definite wave lengths. Hence the spectra of such incandescent vapours will be broken, and consist only of a series of fine lines.

With imperfect gases, or vapours not far removed from their points of saturation, the intermediate phenomenon of spectra broken, but consisting of bands, is to be expected: when, however, the temperature of such vapours is sufficiently increased, a change from spectra consisting of bands to spectra consisting of fine lines is to be looked for. This change has been observed in many cases.

When a solid body is incandescent, the light emitted so as nearly to graze the surface may be considered due mainly to the surface molecules; but these being free on the side of the surface, but affected by other molecules on all other sides, the internal vibrations in these surface molecules will have a bias in a direction perpendicular to the surface. Thus the vibrations caused in the ether, which are propagated nearly grazing the surface, will preponderate in a direction perpendicular to the surface, or considering the vibrations in plane polarised light to be perpendicular to the plane of polarisation, the light emitted by such a body, so as to pass close to its surface, will be partially plane polarised, the plane of polarisation being parallel to the tangent plane to the surface of the body at the point of emission.

In the case of an incandescent gas, the surface molecules are continually changed, and as a molecule may arrive at the surface in any position, and is equally free on all sides, all trace of polarisation in this light will be destroyed.

The fact that incandescent metallic plates do emit partially plane polarised light in directions nearly grazing the surface, the plane of polarisation being parallel to the surface, and that incandescent gases emit unpolarised light, has been observed by Arago.

As the molecules at or near the surface of solids or liquids can cause vibrations in the ether, giving rise to emitted light, it is to be expected that, in some cases at least, it will be possible for light, if of sufficient intensity, when incident upon a body, to cause vibrations in the atoms constituting the molecules near the surface; but considering the difference of mass of the atoms of the body and of those of the ether, that the atoms of the body will vibrate slower than those of the ether, the actual times of vibration depending, however, upon the molecular forces in the body. As these atomic vibrations will again affect the ether, such bodies will or may become luminous, the wave lengths of the emitted light being, however, longer than those of the incident light which causes the disturbance in the body.

This emitted light will necessarily last some time after the incident light is removed, for the vibrations in the body will not cease as soon as the cause of disturbance is removed, but in general it is to be expected that this emitted light will speedily disappear, though cases may occur in which it will continue for a considerable time.

These probable deductions from the assumed principles coincide exactly with the phenomena of fluorescence and phosphorescence (not including in this term cases in which light is emitted by bodies undergoing slow combustion), all fluorescent bodies being phosphorescent for times of different, though in all cases at present observed, of very short duration.

ACADEMY OF SCIENCES.

December 4, 1865.

M. H. St. Claire Deville read a note "*On the Hydraulicity of Magnesia*" of considerable industrial importance. He said that seven years ago M. Donny sent him a specimen of magnesia prepared by the calcination of the chloride. Some of this, which was in compact anhydrous lumps, he left for several months under a tap in his laboratory, constantly exposed to running water. In this time it took a remarkable consistence, became hard enough to scratch marble, and as translucid as alabaster. After six years' exposure to the air it has in nowise changed, and its analysis gave the following results :—

Water	27·7
Carbonic acid	8·3
Alumina and oxide of iron	1·3
Magnesia	57·1
Sand	5·6
	100·0

Thus the substance appears to be essentially a crystallised hydrate of magnesia, like brucite, which does not absorb carbonic acid. To prove that it really was so, M. Deville prepared magnesia by calcining the nitrate, powdered it, made it into a semi-plastic mass, and sealed it in a tube with some boiled distilled water. After some weeks the mass became as hard and compact as the other, and also crystalline and translucid. After drying in the air this mass was found to have the composition $HO\,30{\cdot}7, MgO\,69{\cdot}3$, showing it to be a simple hydrate of magnesia. With similar magnesia the author took casts of medals, as with plaster of Paris, and on placing the casts in water found them to assume the appearance of marble. M. Balard's magnesia—that is, the magnesia prepared by calcining the chloride obtained by the treatment of sea-water,—calcined at a red-heat shows astonishing hydraulic qualities. Calcined at a white-heat for hours its hydraulic qualities are in part destroyed. A mixture of chalk or marble and magnesia forms with water a plastic mass, which after remaining some time in water becomes extremely hard. With a mixture of equal parts of this magnesia and powdered marble, the author hopes to make busts which by hydration will be converted into artificial marble. A mixture of plaster of Paris and magnesia he finds to break up under water. The next experiments are of great importance. The author finds that a dolomite rich in magnesia when calcined below a dull red-heat and powdered and made into a paste, forms under water a stone of extraordinary hardness. M. Deville exhibited to the Academy specimens he had made with the dolomite used by Messrs. Bell, of Newcastle, for making Epsom salts by Mr. Pattinson's process. When the dolomite is strongly ignited and some quick-lime produced, the mass does not set so well, crystals of arragonite separating in thin veins. When dolomite is heated to bright redness, and all the chalk converted into quick-lime, the paste formed with it breaks up in water. All the experiments, M. Deville states, show that the magnesia is the binding material, which in becoming hydrated holds together the particles of chalk or marble to form a compact homogeneous stone. He has exposed some of the stones to the action of the sea in the port of Boulogne, and they at present remain unaltered. The facts contained in this note proved the perfect hydraulicity of pure magnesia by the formation of a definite hydrate.

The experiments with dolomite are of the most importance to us, and no doubt some of our readers will follow up the experiments made by the accomplished author of this note.

M. Cloez presented a third memoir "*On the Oxidation of Fatty Vegetable Oils.*" It contains nothing that the author has not said before; but we give a summary. It has been commonly supposed that the presence of albuminoid matter, mucilage, &c., in vegetable oils promote their oxidation. This, M. Cloez assures us, is not the fact. Oils perfectly free from such matters oxidise as rapidly in the air as those contaminated by them. He then proceeds to show that the resinification of oils is owing to the subtraction of carbon and hydrogen and the addition of oxygen. Only a part of the carbon disappears in the form of carbonic acid, the rest escaping in the acid, acrid, suffocating vapours which give the odour called *rancid* to the oil. When the oxidation takes place in a confined space these acid vapours accumulate, and may produce bad effects on animals or individuals who breathe them. Among the vapours will be found formic, acetic, acrylic, and butyric acids, and probably acroleine. Most of these arise from the decomposition of glycerine, butyric acid alone resulting from the oxidation of the fatty acid. The elastic, resinous, solid matter left after the complete oxidation of linseed oil has, according to the author, a very complex composition, which he does not attempt to unravel, but only describes its appearance, well known, no doubt, to all our readers. Submitted to the action of heat, oxidised linseed oil, M. Cloez tells us, deepens in colours, swells up, gives off a suffocating odour, succinic acid, inflammable hydrocarbons, and in the end leaves a carbonaceous residue in the retort. Boiling water has little action on the oxidised oil; alcohol and ether dissolve out a thick fatty matter, which, among other substances, contains unchanged margaric and oleic acids. M. Cloez sums up the results of his investigations as follows :—1. All fatty oils, without exception, absorb oxygen from the air, and increase in weight. 2. Elevation of temperature facilitates the operation. 3. Intensity of light also has a marked influence on the progress of the phenomenon. 4. Light transmitted through coloured glass retards the oxidation. Starting from colourless glass, the retardation is increased by coloured glass in the following order:—Blue, violet, red, green, yellow—that is, oil covered with yellow glass, oxidises most slowly. 5. In the dark the oxidation progresses very slowly. 6. The presence of various matters accelerate oxidation. 7. In the resinification there is a loss of carbon and hydrogen and an assimilation of oxygen. 8. The various oils in oxidising furnish the same products; gaseous and volatile compound acids, unchanged solid and liquid fatty acids, and a solid, insoluble matter, which appears to be a definite immediate principle. Oils oxidised in the air no longer contain glycerine. 9. Lastly, drying oils do not differ chemically from the non-siccative oils.

M. G. Jean sent a note "*On Ozone, and the Splitting up of Carbonic Acid into Ozonised Oxygen and Carbonic Oxide, under the influence of Electricity.*" The author employed an induction coil, provided with a peculiar condenser, for dividing the spark into an infinite number of very feeble sparks. By this apparatus, he says, he proved that carbonic acid, under the influence of the sparks, split up into carbonic oxide and oxygen; and the odour and other tests showed that the oxygen was strongly ozonised. Atmospheric air exposed to the same influence becomes ozonised, and forms nitric acid (?), which suddenly decomposes into nitrous acid when the air is heated. There are some other curious things in the note, from which we shall only further quote the account of the properties of ozone. Ozonised oxygen, the author says, has the property of giving rise to vapours when mixed with sulphurous or nitrous acids, and these vapours are very persistent in the presence of ammonia and iodine. Crystals of iodine dropped into a vessel of ozonised oxygen also gives rise to a very thick vapour, which gradually precipitates in the form of iodic acid. A coating of linseed oil on glass exposed to ozonised oxygen became dry in an hour, and its weight was found to have increased by 20 per cent. The quantity actually absorbed, the author stated, must have been much more considerable, for it was disengaged in the form of strongly-smelling acid vapours.

M. Simonin communicated some determinations of the "*Pressure and Temperature of the Air in Mines.*" His results do not enable him to establish any general laws, but the mean of four experiments at the coal mines of Creuzot and Epinac gave a rise of one degree (C.) of temperature for every 45 metres of vertical descent; and a rise of one millimetre in the barometer for every 10½ metres of vertical descent.

An account of "*The Mineral Waters of Atami, Japan,*" by M. Lemoyne, was read. The source of these is an intermittent spouting hot spring, similar to the Geysers of Iceland. The temperature of the water the author found to be 95° C. The composition, as given, shows nothing particular, but the examination was necessarily incomplete. The water is used (externally) by the Japanese for rheumatic affections and diseases of the skin.

M. J. Personne sent a note "*On the Decoloration of Iodide of Starch by Heat,*" in which he admitted the explanation of M. Payen to be correct (see page 155), but claimed the first publication of the explanation. He added, however, that the decolouration may be the result of three different causes:—1. The disappearance of part of the iodine driven off by the heat; 2, the disappearance of another part to form a sort of compound, still unknown, with starch, the colourless solution of which becomes blue on the addition of chlorine or nitric acid; and 3, the modification undergone by starch under the influence of iodine, whereby it is rendered completely soluble, and even converted into glucose.

M. J. E. Petrequin re-opened the case "*Ether v. Chloroform.*" The surgeons in Lyons, he stated, have for fifteen or sixteen years used pure ether as an anæsthetic, to the entire exclusion of chloroform, with the happiest effects, and no fatalities. He showed that the ill effects sometimes produced by ether always come on gradually, and may be relieved, while chloroform often kills like a lightning stroke. He stated also that with pure rectified ether complete anæsthesia is produced in six or seven minutes; and who, he asked, would endanger the life of a patient to save two or three minutes of time? He concluded a paper which deserves the serious attention of all surgeons by stating that the object of his ambition was to put a stop to the lamentable martyrology of chloroform.

M. Velpeau addressed the Academy, and said that he had had many thousands of patients under chloroform, and had never lost one by it! He thought that ether and chloroform might have their respective advantages, and it would be well to keep both in use.

M. Villemin presented a note "*On the Cause and Nature of Tuberculosis,*" in which he showed that this disease is communicable by inoculation. He inoculated some rabbits with tuberculous matter from the lung of a man who had died of phthisis, and in every instance found tubercles in the lungs of the animal, and often deposits in other parts of the body. The author concludes that tuberculosis is a specific affection, and that its cause resides in an inoculable agent. The disease may, therefore, range nosologically by the side of syphilis, but stands nearer to glanders.

NOTICES OF BOOKS.

The Fairy Tales of Science. A Book for Youth. By J. C. Brough. With sixteen illustrations by C. H. Bennett. London: Griffith and Farren. 1866. (Second edition, revised by the author.)

At this season of the year there are always anxious parents and affectionate friends in search of a book to give to intelligent youths in whose minds they wish to see a love of science spring up. Mr. Brough has furnished them with exactly the book they want. It is a book a boy will read with enjoyment, and having read it, will be pretty certain to wish for an extended knowledge of the wondrous things here lightly sketched to stimulate his curiosity. The subjects are very varied, embracing something of every science; but everything is told in a simple but exciting way. Thus, in "the life of an atom," the author makes an atom of carbon tell the story of some of its migrations through animate and inanimate nature. Once, in primitive times, a portion of solid rock, then set free by volcanic agency to be seized by a plant and lie buried for ages, until again brought to the surface in the form of coal, only to be once more dissipated in air and again caught by a plant, and now fixed in a grain of wheat; then becoming part of a human organism, to be again cast forth and enter a tree; and in time, reduced to charcoal, enter a steel blade, in which stage of existence it witnesses fearful scenes of bloodshed. But "when," says the atom, "I speak of these scenes as fearful, I make use of a human expression; for I need scarcely say that death has no terror for an undying atom." The atom follows his history a few stages further, and then concludes:—

"Such is the story of my life, or, rather, of a fragment of my life. I enjoy perpetual youth. To-day I may be buried in a mass of corruption; but to-morrow I may form part of a newly-opened rose. Time cannot reach me; his hour-glass may be shattered and his scythe broken, but still I shall exist. At the present moment I am joined to countless other atoms, indestructible and eternal like myself, in a fragment of sugar; but who can tell where I shall be in a year's time?"

We might make almost any number of quotations as interesting as that above; but we prefer to commend the entire book to our readers as the best we are acquainted with to give a studious youth. A word of praise must also be given to Mr. C. H. Bennett for his drawings, which are full of humour, and in some cases eminently suggestive.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

2892. T. Redwood, Montague Street, Russell Square, Middlesex, "Improvements in the preservation of meat and the concentration of its juices."—Petition recorded Nov. 10, 1865.

2934. J. T. A. Mallet, Boulevart St. Martin, Paris, "A new or improved process for the manufacture of oxygen."—Nov. 14, 1865.

2970. G. Taylor and J. Fernie, Leeds, "An improvement in the manufacture of steel castings."—Nov. 18, 1865.

3009. T. Redwood, Montague Street, Russell Square, Middlesex, "Improvements in the preservation of animal substances, such improvements being especially useful when these substances are intended for use as food."—Nov. 23, 1865.

3025. W. A. Lyttle, General Post Office, London, "Improvements in furnaces."—Nov. 25, 1865.

3043. W. R. Lake, Southampton Buildings, Chancery Lane, "Improvements in the mode of, and means for, preserving fruit and other perishable substances."—A communication from B. M. Nice, Cleveland, Ohio, U.S.A. —Nov. 27, 1865.

3047. C. H. Newman, Chertsey, Surrey, "A new kind of unfermented and unintoxicating malt liquor, which shall keep sound for any period of time."—Nov. 28, 1865.

3067. C. S. Baker, Fleet Street, London, "Improvements in the process of treating materials for the manufacture of paper and other similar textile fabrics, and in apparatus for the same."—A communication from R. H. Collyer, Pont An-demer, Eure, France.—Nov. 29, 1865.

CORRESPONDENCE.

The "Cosmos" and the Poisoning by Mercuric Methide.

To the Editor of the Chemical News.

Sir,—Your French correspondent, referring, in your last number, to the recent letters in the *Cosmos* about the poisoning of the two assistants, Dr. C. U—— and Mr. T. C——, in the chemical laboratory at St. Bartholomew's Hospital, has given a very extraordinary misrepresentation of the facts, which I can hardly attribute to his imperfect knowledge of the French language. In my usual "English Correspondence" in the *Cosmos*, I stated that this sad affair occurred under the direction of Dr. Frankland, who *was* Professor at the Hospital, a mistake corrected immediately. I am, &c.

T. L. PHIPSON, Ph.D., F.C.S.,
One of the Editors of the *Cosmos*.

London, December 9.

[We insert the part of Dr. Phipson's letter which concerns our correspondent, but must decline to make the CHEMICAL NEWS a vehicle for other recriminations.—ED. C. N.]

Associate of the Royal School of Mines.

To the Editor of the CHEMICAL NEWS.

SIR,—In reply to the inquiry made by Mr. Denham Smith in your last number, I desire to inform your readers that the title of "Associate of the Royal School of Mines" is granted under conditions sanctioned by the Lords of the Committee of Council on Education and by their authority. The certificates of Associateship are signed by the Lord President. I am, &c.

TRENHAM REEKS, Registrar.

Royal School of Mines, December 6.

Utilisation of Soda Waste and Chlorine Residues.

To the Editor of the CHEMICAL NEWS.

SIR,—On reading M. Kopp's last letter, in No. 313 of the CHEMICAL NEWS, I am particularly struck with the coincidence of his results with my own experiments. As a labourer in the same field, it gives me much pleasure in confirming his figures.

His plan of oxidising the alkali waste is very simple and ingenious, and I would also expect that it will work effectually. I see, however, that M. Kopp still remains under the impression that his process is quite original, and that it has not been patented in England. To correct this, allow me to refer him to Townsend and Walker's patent, No. 3038, dated 11th December, 1860. He will find there the identical process which he now describes, and from which permit me to give a brief quotation:—

"First, the solutions (sulphide of calcium and still liquor) may be mixed in such proportions that the resulting precipitate will consist chiefly of sulphur.

"Second, the solutions may be so proportioned that the resulting precipitate will consist chiefly of free sulphur and sulphide of iron.

"Third, the solutions may be so proportioned that the precipitate will consist of free sulphur, sulphide of iron, and sulphide of manganese."

It will be observed that these propositions deal essentially with solutions, and not with the alkali waste itself, as M. Kopp has supposed.

The composition of the precipitates obtained as above tallies closely with that given by M. Kopp; the first gives 90 per cent. sulphur, the second 70, and the third 45 to 50. It is in dealing with the third precipitate that the stumbling-block occurs which I referred to in my last letter; and I can assure M. Kopp that many were the resolute attempts to remove it, but all in vain. There it stands still, as ugly as ever, and the figures given by M. Kopp establish this beyond a doubt.

He commences with a precipitate containing 50 per cent. sulphur, which he calls a sulphuretted sulphuret of manganese; but I look upon it as simply a mixture of sulphur, sulphide of iron, and sulphide of manganese. From two tons of such a precipitate he obtains 14 to 16 cwt. of sulphur, in the form of sulphurous acid; the other 4 to 6 cwt. remains combined with the manganese in the form of sulphate. This may be looked upon as the most favourable results which could be obtained, as it will vary with the description of manganese ore used; the purer the manganese the more will the sulphur be retained in the burned precipitate, and with some varieties not more than ten cwt. of sulphur could be obtained from two tons of precipitate.

In adopting any new process, I consider that the most adverse facts should be looked full in the face; and I only point out these drawbacks not to deter any one from adopting it, but simply that the process should be estimated at its real worth.

It would be strange, indeed, if I would deliberately condemn without reason a process which I laboured so much at to perfect. As it stands, it is only a partial success. At least one-third of the sulphur is lost after being precipitated, and the residue is absolutely worthless unless some use can be made of sulphate of manganese.

I would suggest as an improvement on M. Kopp's proposed arrangement of processes that the manganese should not be precipated at all, but that the process should be conducted in accordance with the second proposition in Townsend and Walker's patent, adding M. Kopp's proposal to utilise the sulphuretted hydrogen. By this means a precipitate containing 70 per cent. of sulphur would be obtained, and all the sulphur would be recoverable as sulphurous acid, leaving very little residue.

As to priority of invention, I can only say that the processes were devised by Mr. Townsend and me five years ago, quite independent of any knowledge of M. Kopp's labours in the same direction; and if M. Kopp knew and published all the facts as they stand described by us before that time, he is then entitled to claim priority.

I am, &c. JAS. WALKER.

275, St. George's Road, Glasgow, Dec. 11.

MISCELLANEOUS.

Chemical Society.—The next meeting of this Society will take place on Thursday evening next, at 8 o'clock, when a paper, by Mr. J. Yates, will be read, "On the Material for Mural Standards of Length."

Royal Institution of Great Britain.—The following are the lecture arrangements for the ensuing season:—*Christmas Lectures*, 1865, *adapted to a juvenile auditory.*—Prof. Tyndall, F.R.S., six lectures "On Sound." *Before Easter*, 1866.—Prof. Tyndall, F.R.S., twelve lectures "On Heat;" Prof. Frankland, F.R.S., eight lectures "On Chemistry;" Prof. R. Westmacott, R.A., F.R.S., six lectures "On the Way to Observe in Fine Arts;" Rev. G. Henslow, four lectures "On Structural and Systematic Botany, considered with reference to Education and Self-instruction." *After Easter.*—Prof. Frankland, F.R.S., four lectures "On Chemistry;" G. Scharf, Esq., Secretary and Keeper of National Portrait Gallery, three lectures "On National Portraits;" Rev. C. Kingsley, M.A., two lectures "On Science and Superstition;" Prof. Huxley, F.R.S., twelve lectures "On the Physiological Methods and Results of Ethnology;" Prof. Ansted, F.R.S., five lectures "On the Application of Physical Geography and Geology to the Fine Arts;" an extra course may possibly be given by Dr. Du Bois Reymond "On Electric Fish."

ANSWERS TO CORRESPONDENTS.

Dr. Muspratt.—Next week.

E. Osborne.—The proportions are given in Dr. Stenhouse's patent specification. Boiled oil is used to the extent Dr. Calvert says—a small percentage of the paraffine.

H. R.—There is a French book on the subject of pyrotechny; but we know of no separate work in English on the subject that is not very old. The last volume published of Knapp and Richardson's "Technology" has an excellent article on fireworks.

Clericus.—Aniline black is formed on the material dyed purple by treating the fabric with a dilute solution of bichromate of potassium, or according to Lauth's process. See CHEMICAL NEWS, vol. xi., p. [illegible] No aniline black is sold that we know of.

Received.—John Cliff; A. G. Anderson, next week.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Researches on the Volatile Hydrocarbons, *by* C. M. Warren.[*]

(Continued from page 280.)

On commencing the account of his own researches, the author first mentions the source of the naphtha used in the experiments. It was obtained from various American gas works in which, however, cannel and Newcastle caking-coal were chiefly employed. In some a Pennsylvanian caking-coal was also used. The coals were employed in the same proportions as in England. The process for purifying the naphtha was the same as that in use here—namely, treatment with oil of vitriol and alkali, and subsequent rectification and fractionation. Very large quantities were operated upon to ensure the detection of any constituent which might be present in small proportion. The process of fractioning was continued on the large scale until the separations had so far progressed that at certain temperatures a full barrel of distillate would come off from the ten barrel still employed without a variation of more than one or two degrees of the thermometer. Finally, a sample gallon was taken from each of the barrels composing the last series of products, and then set aside for the laboratory investigations.

In the laboratory the fractionings were made by the author's process of fractional condensation described *ante* p. 85.

They were continued until the whole of the naphtha taken, boiling between 80° and 170°, had accumulated at the four points indicated—viz., at 80°, 110°, 140°, and 170°, or so nearly the whole that the intermediate quantities had become too small to admit of being further operated upon. Having so thoroughly exhausted the intermediate fractions, Mr. Warren says, I can have no hesitation in asserting that no other body than those alluded to was present in the naphtha—at least, in appreciable quantity—hence that the parabenzole of Church was probably only a mixture of benzole and toluole.

On some Properties of the Bodies obtained by Fractioning.

I. **Benzole.**—Sp. gr. 0·8957 at 0°, and 0·882 at 15·5°. The experiment to determine the boiling point was conducted in a tubulated retort, operating on 150—200 c.c. of the benzole, containing some pieces of sodium. The benzole employed had previously been repeatedly boiled with sodium until the latter ceased to have any action. The thermometer bulb extended into the liquid[†] nearly to the bottom of the retort. A second thermometer was attached by means of flexible bands to the side of the one in the retort; the bulb being placed during the ebullition at a point midway between the centre of the cork (—5°) and the upper end of the mercurial column —viz., at 35°. A paper screen closely fitting the thermometer spindle was placed across at the top of the cork. With the retort neck slightly inclined upward and cooled to prevent the escape of vapour, ebullition was continued for considerable time, until the mercury in the thermometer ceased to rise. The lamp being removed for an instant, the neck of the retort was turned downward and quickly inserted in a Liebig's condenser. On replacing the lamp, distillation commenced almost immediately at 97°. The distillation occupied an hour and ten minutes, during which time the thermometer rose only 0·6°, being fifty minutes in rising 0·2° from 79·4° to 79·6°, at which temperature it had distilled nearly to dryness. Height of the barometer during the experiment reduced to 0° = 761·9 mm. Taking 79·4°, this being the average of the last five observations, and applying the corrections for the upper column of mercury and for atmospheric pressure, according to the directions given by Kopp, we find the corrected boiling point of benzole to be 80·1°.

Analysis.—(In most cases we abridge the details of the determinations) 0·2339 of benzole gave by combustion in a stream of oxygen gas 0·7903 of carbonic acid, and 0·1683 of water.

		Calculated.		Found.
Carbon .	. C_{12}	72	92·31	92·15
Hydrogen	. H_6	6	7·69	7·99
		78	100·00	100·14

Density of vapour found . . 2·688
Theory $C_{12}H_6 = 4$ volumes . . 2·698

II. **Toluole.**—Sp. gr. 0·8824 at 0° and 0·872 at 15°. The preparation used for determining the boiling point was repeatedly boiled with sodium. The experiment was conducted as with the benzole. Operating upon a considerable quantity the distillation occupied about an hour. It commenced at 110·6°; two minutes later the temperature had fallen to 110·4°, at which point it remained absolutely constant for forty-eight minutes. Five minutes later the temperature had risen again to 110·6°, and five minutes later to 110·8°, at which point the operation was suspended. The corrections made as in the case of benzole gives 110·3° as the corrected boiling point of toluole. Church remarks that toluole when distilled in the ordinary manner is liable to become oxidised, and its boiling point thereby raised in consequence of the upper part of the retort becoming heated above the boiling-point of toluole. He found that the toluole which by ordinary distillation had come over between 108° and 109° would distil eight tenths between 103° and 104°, after repeated rectification with sodium. I would therefore state that my preparation of toluole was never subjected to a higher temperature than its boiling point; and that I have never noticed any reduction of the boiling point of this body by purification with sodium.

Analysis.—0·1628 grm. of toluole by combustion in a stream of oxygen gave 0·5447 of carbonic acid and 0·1315 of water.

		Calculated.		Found.
Carbon .	. C_{14}	84	91·3	91·20
Hydrogen .	. H_8	8	8·7	8·97
		92	100·0	100·17

Density of vapour found . . 3·2196
Theory $C_{14}H_8 = 4$ volumes . 3·1822

III. **Xylole** (*Cumole of Mansfield and Ritthausen*). —Sp. gr. 0·178 at 0° and 0·866 at 15·°5. The method of determining the boiling point was the same as before, the xylole having been subjected to the same treatment. The quantity operated on was smaller, and the experiment conducted more rapidly. Distillation begun at 138·6° and ended 139°, having distilled almost to dryness. Taking the average—viz., 138·4°, and making customary corrections, we find 139·8° to be the corrected boiling point of xylole.

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[*] Abridged from the Memoirs of the American Academy.

[†] The author has some critical remarks on the propriety of placing the bulb in the liquid, which we shall give on a future occasion.

Analysis.—0·1333 grm. gave by combustion as before 0·4413 of carbonic acid, and 0·1185 of water.

Density of vapour found . . 3·7517
Theory $C_{16}H_{10}$ . . . . . 3·6665

The results show that this body has the formula $C_{16}H_{10}$, and that it is doubtless the third member of the benzole series.[‡] Although xylole—first discovered by Cahours in the light oil separated from wood spirit—has had a much lower boiling-point assigned to it, I have retained the name for this body, since the results which I have obtained in the study of the light oil from wood-tar indicate that when the corresponding body from this source is in an equal state of purity its boiling-point will agree with the above determinations. I may here mention that I have obtained a body from wood-tar at about 140°, but nothing between that and 110°, although special pains were taken with the intermediate fractions. That this body boiling at 140° is not identical with cumole from cuminic acid will be made apparent hereafter.

IV. Isocumole (*Cymole of Mansfield*).—Sp. gr. 0·8643 at 0° and 0·853 at 15°. The boiling-point was determined with the usual precautions. Before distillation commenced the temperature of the boiling liquid was 196·5°; at the close (near dryness), 167°. With the customary corrections for the average, viz., 166·75°, we obtain for the corrected boiling point 169·8°.

Analysis.—0·1944 grm. gave by combustion, as before, 0·6366 of carbonic acid and 0·1896 of water.

		Calculated.		Found.
Carbon .	. C_{18}	108	90·00	89·31
Hydrogen	. H_{12}	12	10·00	10·84
		120	100·00	100·15

Density of vapour found . . 4·3019
Theory . . . . . . 4·151

Hence it appears that the calculated density on the formula $C_{18}H_{12}$ is 0·151 *less* than that found by experiment. The calculated density on the formula $C_{20}H_{14}$ previously assigned to this body, though without analysis or determination of vapour-density, is 4·645, which is 0·302 *greater* than that found by experiment.

It will be observed that the difference between the density found and that calculated on the formula $C_{20}H_{14}$ is not only twice as large as the corresponding density calculated on the formula $C_{18}H_{12}$, but that the error is reversed; being with $C_{20}H_{14}$ a *deficiency*, while with $C_{18}H_{12}$ it is an *excess*. This circumstance goes strongly to show that the lower formula is the true one. I have but rarely met with an instance in which the density found was not greater than the theoretical density; and I have usually observed that the excess of the experimental over the theoretical density is larger in proportion as the boiling-point of the body is higher—a fact which needs explanation. Wurtz observed a similar difference between the determined and calculated vapour densities of bodies of the formulæ $CnHn$ and $CnHn+2$, which he accounted for on the ground that his preparations contained an admixture of bodies less volatile, the vapours of which would remain in the balloon and increase the density. But I do not accept this explanation for the substances here treated of, since they invariably distil without residue within a range of one degree of temperature. I would rather rely on the supposition that the high temperature employed causes partial decomposition of the substance, which would be more liable to occur the higher the boiling point of the body. I do not, however, offer this as an explanation, but merely make the suggestion.

Remarks on Mr. Warren's "Researches on the Volatile Hydrocarbons," by A. H. CHURCH.

In the CHEMICAL NEWS of December 15, an account of Mr. C. M. Warren's careful experiments on the benzole series is commenced. The way in which some of my early results are criticised compels me to refer at once to several of his statements.

Mr. Warren cannot confirm all the results of the late Mr. Mansfield, but when this chemist's views are believed to have been incorrect they are spoken of as "an expression of opinion in advance of anticipated results;" but when I am wrong, or supposed to be so, I am severely handled. I am quite ready to admit that my own opinions have in several respects been altered by further researches; while the admirable method of fractionating perfected by Mr. Warren has enabled him to work far more satisfactorily than was possible at the time I tried my experiments on the subject—just eleven years ago.

I regret that Mr. Warren has not made himself acquainted with all my papers and notes on the benzole series. Some of the results which he disputes I have already corrected, others I now interpret differently, while one or two of his own discoveries I have anticipated.

I. Benzole Series.—No chemist disputes the boiling points assigned to benzole, cumole, and cymole—the benzole being obtained from coal naphtha and from benzoic acid, the cumole from cuminic acid, and the cymole from oil of cumin. My own results published in 1855 were not new; they merely confirmed very strongly the results of others:—Benzole, 80·8° C.; Cumole, 148·4° C.; Cymole, 170·7° C. But I unintentionally conveyed the impression that these particular boiling points with those of toluole and xylole had been taken with coal naphtha products in every case. The identity of the hydrocarbons from various sources I had accepted too implicitly second hand, but I did not regard it as a new discovery of my own.

With regard to toluole and xylole the case is different. The xylole which I obtained with a constant boiling point of 126·2°, I expressly stated in my paper in the *Philosophical Magazine* for June 1855 to have been derived from wood spirit. This determination does not differ widely from that of Cahours—126°. My reasons for believing a hydrocarbon of the same formula to exist in coal naphtha are fully given in this latter paper.

My determination of the boiling point of toluole does not differ widely from the results obtained by Glénard and Boudault, and has been since confirmed by Max Dürre. These three determinations are, 103·7°, 106° and 104°.

II. Parabenzole Series.—I am still convinced of the existence of a series of hydrocarbons in coal naphtha isomeric but not identical with that to which benzole belongs. The mere non-discovery of parabenzole in any specimen of coal naphtha cannot be taken as proving the non-existence of this body. The differences in boiling point, liquid density, solubility in oil of vitriol, and specific refractive energy between benzole and parabenzole I have already fully described. When the abstract of Mr. Warren's memoir is concluded I may recur to this point.

[‡] In a note the author refers to the publications of Hugo Müller, Béchamp, and Naquet, September, 1864. Müller's results, he says, agree with his own. Béchamp erroneously regards it as a *new* hydrocarbon, not belonging to the benzole series. Naquet calls it a *new* hydrocarbon, and gives the formula $C_{18}H_{12}$.

It is curious to notice that Mr. Warren, while disputing most of my results, actually confirms one of the most important of them, though he does this unwittingly. He describes the hydrocarbon boiling at 140° as having the formula, $C_{16}H_{10}$, assigned to xylole. This is exactly what I have myself affirmed. The detection, &c., of this hydrocarbon is a discovery to which I lay claim. I have already named this liquid para-xylole and assigned the formula $C_{16}H_{10}$ to it, and found it to boil between 140° and 141°.

On the Formation of Glucose by Leaves, by M. Boussingault.*

The supposition that the production of glucose and its congeners is principally effected by the aërial organs of plants is contradicted by the abundance of saccharine matter in the stalks, the roots, and especially by the formation of the same matter during germination, when the leaves are not yet formed. But the germination only transforms starch into glucose, sugar, and cellulose; it brings no combustible element; on the contrary, the embryo, for its nourishment, consumes those pre-existent in the seed.

By looking at the vegetable world in its entirety, one is convinced that the leaf is the first resting place of the glucosides, which, more or less modified, are found scattered in various parts of the organism; that it is the leaf which elaborates them, at the expense of the carbonic acid and water. In maize, wheat, &c., the accumulation of saccharine principles takes place in the stalk, up to the time of flowering, when all that has been formed assists in the formation of the seed. In beetroot this receptacle is the principal fleshy root. But where there is neither stalk nor root, where is the saccharine matter formed by the leaf deposited? In the leaf itself, which is then considerably extended. The most striking example is presented by the American agave, the maquey, the vine of the Mexicans, the culture of which extends from the time of Montezuma and further. The leaves of the agave all grow from the neck of the root; they attain 2 metres in length, 20 centimetres in breadth, and 1 decimetre at the point of attachment. During from fifteen to twenty years these leaves elaborate and accumulate glucose, until the stalk which is to bear the flowers and fruits begins to form. Then the large, coriaceous prickle-edged leaves, after having remained so long inclined to the ground, raise themselves and approach the conical bud, as if to cover and protect it. Then there is a very apparent and gradual movement, seeming to obey a will. The bud lengthens with surprising rapidity, and a flower-stalk, 5 or 6 metres in length, is soon formed. The work of reproducing the seed is thus accomplished, and it is by preventing this that the Indians procure an ample harvest of the sweet sap, by fermenting which they prepare pulqué, their favourite intoxicating drink. One agave plant, in the environs of Chelula, yields in four or five months nearly 1 cubic metre of sweet liquid, after which it dies exhausted, as it would also die exhausted were the stalk allowed to develope and bear flowers and fruit. An agave yields in four months about 100 kilogrammes of glucose, prepared and preserved by its leaves for years.†

There is no doubt as to the origin of this glucose; it proceeds from the carbonic acid and water decomposed by the leaves.

To conclude, I trust my experiments will enable me to dispute the direct formation of saccharine matter by the green parts of vegetables exposed to the sun.

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* *Comptes Rendus*, lxi., 664.

† See Boussingault "Sur le Pulqué;" report made to the Imperial Commission for Mexico.

On the Supposed Nature of Air prior to the Discovery of Oxygen, by George F. Rodwell, *F.C.S.*

(Continued from page 74.)

XIV. Rise of Pneumatic Chemistry.—We can scarcely be surprised that the air received but little attention till a comparatively late period in the history of the world, when we remember that there existed no means of ascertaining even its most salient properties. Inquiries into the nature of an intangible and invisible body, which exercises no apparent effect upon the matter around it, belong to a somewhat advanced stage of experimental philosophy; they require the assistance of a large amount of collateral knowledge, of a refined manipulation, of a mind tutored in the mode of physical thought, and used to the classification of diverse phenomena. The most obvious property of matter is its visibility, and the conception of it divested of that property is no small effort to an ordinary mind: we all know the invariable wonderment produced at a popular lecture when carbonic acid is poured upon a lighted taper, or when hydrochloric acid gas and ammoniacal gas are brought into contact. When we call to mind the ideas which obtain among the unscientific in the present day in regard to gaseous bodies, we cannot wonder that so little was formerly known of the air.

The ancients, although they classed air among the four elements from which they conceived the world had been produced, had no definite idea of its nature. Many philosophers doubted whether it were material, and the great mass of the people scarcely recognised its existence. The fact adduced to prove its materiality (the simplest and most obvious that could occur to the mind) was that it could be felt when in motion—viz., as wind. Anaxagoras went a step further, and urged as an additional proof (*a*) that a blown bladder resists compression, and (*b*) that an inverted drinking vessel when plunged beneath the surface of water is found to remain perfectly dry inside, which would not be the case, he argues, unless something material had prevented the ingress of the water. But these crude experiments merely proved that the air is matter.

Then, again, the experiment of burning a candle in a closed vessel standing over water, could throw no light on the nature of the air, as it could not be rightly explained in the then state of science. It may be considered the earliest experiment in pneumatic chemistry; it is mentioned by almost every Middle Age writer on alchemy and chemistry, but scarcely two give a similar explanation of the phenomena observed; nor is this to be wondered at when we remember the amount of chemical knowledge required for its explanation. To explain it in its entirety it was necessary to know (*a*) that the air is composed of two gases; (*b*) that they are insoluble in water; (*c*) that during combustion one of them unites with the burning body; (*d*) that a gas soluble in water is the result; (*e*) that the other gas cannot unite with the burning body; and (*f*) that in a known volume of air there are four volumes of the latter gas to one of the former. No wonder the experiment puzzled the scientific mind for so many centuries. No wonder it became a habit to fasten a pet theory upon it, or to propound one specially for its explanation. Those old philosophers who with difficulty spun out a page or two about it, little thought how much was linked with the true explanation of the experiment, how their ponderous and unwieldy theories, upon which so much thought had been expended, so little experiment, would have disappeared utterly; how the face of science would be changed when a new race of thinkers, working slowly and laboriously, were destined to elucidate each phase of the experiment.

But although this experiment remained unexplained, it proved to the more observant the important fact that flame requires air for its sustenance—a fact which, although by no means generally admitted, found supporters from the time of Hero of Alexandria. One of the first air-pump experiments tried by Otto Von Guericke was for the purpose of ascertaining whether a candle would continue to burn in an exhausted receiver; and Boyle, in his first pneumatic treatise (1660), mentions several proofs that combustion cannot proceed in a space void of air. In an essay on this subject,[*] published by Boyle in 1672, we find hydrogen for the first time recognised as an inflammable body. Among other experiments, he poured upon iron filings "a saline spirit, which by an uncommon way of preparation, was made exceeding sharp and piercing;" immediately "fumes" were given off, which proved to be inflammable. When allowed to burn within an air-pump receiver, the flame suddenly enlarged itself on exhausting, and then went out altogether. Boyle does not appear to have studied the properties of the new gas, but contents himself with suggesting that it consists either of "the volatile sulphur of Mars, or of metalline steams participating of a sulphurous nature."

Boyle also published in 1672 an essay entitled "*Fire and flame weighed in a balance*," in which are detailed a number of experiments made to determine the amount gained by certain metals during calcination. We have previously[†] considered at some length John Rey's important treatise on this subject, published forty-two years earlier. One of the first papers read before the Royal Society (February 23, 1661) was "*On the weight of bodies increased in the fire.*" The experiments were made by Lord Brouncker at the Tower of London, and are given in detail in Sprat's "History of the Royal Society;" but they are by no means concordant—so little so, indeed, that it was not considered as a proved fact that metals gain weight at all during calcination, for we find on March 20, 1661—"The amanuensis was ordered to make the experiment of the calcination of antimony whether it increaseth or not; and to weigh it before and after, in and out of the water."

Boyle found that an ounce of copper filings heated to redness for two hours gained forty-nine grains, while an ounce of tin gained one drachm during calcination. Tin and lead heated in hermetically sealed vessels, underwent partial calcination, from which Boyle inferred that "glass is pervious to the ponderous parts of flame," and that the gain of weight during calcination arises from "extinguished flame" assimilated by the calx. Boyle reduced lead from its calx, hence he considers a calx neither the "caput mortuum" nor the "terra damnata" of the body calcined, as was generally believed, but rather as the body submitted to calcination *plus* something absorbed during calcination. It is curious that Boyle, who had worked upon the air with certainly more assiduity than any of his contemporaries, should not have attributed the increase of weight of calces to the action of the air upon the body calcined; more especially as in a treatise published in 1674 ("*Suspicions about some hidden qualites of the air*") he mentions that marcasite when exposed to the air becomes covered with a body of a vitriolic nature; he also considers that the efflorescence on walls comes from the air, and suggests there is a something of a solar or astral nature, possibly "a volatile nitre," dispersed throughout the air, and necessary for the sustenance of life and flame. As an additional reason for believing that there is some "hidden quality" in the air, he mentions that he made a liquid of "sublimate, copper, and spirit of salt," which was of a dirty red colour so long as it was kept in a closed phial, but when exposed to the air it changed to "a green exceedingly lovely."

I have mentioned above Boyle's supposition that there is "*a volatile nitre*" in the air, and this leads us to the consideration of that which I conceive forms the basis of pneumatic chemistry—the recognition of a connexion between the air and nitre. We shall find as we proceed the vast importance of the experiments which were made to determine the nature of that connexion.

Let us first understand how such dissimilar bodies came to be classed together. In the *Novum Organum*, Bacon urges the necessity of collecting together what he calls "a number of instances agreeing in one form." "Inquisitio formarum," he writes,[‡] "sic procedit; super naturam datam primo facienda est comparentia ad intellectum omnium instantiarum notarum, quæ in eadem natura conveniunt, per materias licet dissimillimas." Following out this last clause to the very letter, Bacon takes the heat of the sun as the first "instance agreeing in the form of heat," and classes with it the skins of animals and oil of vitriol, on the ground that the former (as he supposed) contained heat, and the latter burnt linen. On the same principle (and certainly with equal reason) some philosophers traced a relationship between the air and nitre:—nitre, when thrown upon red-hot coals, produces very intense ignition; a blast of air directed upon red-hot coals produces the same effect, the two instances obviously "in eadem natura conveniunt, per materias licet dissimillimas." This mode of procedure may appear crude and likely to mislead, when we consider Bacon's classification of instances agreeing in the form of heat, but it must be remembered that he gives negative instances which qualify the former, and enable the mind to decide whether certain instances which appear at first sight to agree may really be admitted as such. Moreover, the classification is only to be temporarily made, and then to be tested rigidly by experiment. The classification of the air with nitre (as also Newton's familiar classification of the diamond with combustible bodies), belong to that class of instances called by Bacon "instantiæ conformes sive proportionatæ," which he defines as "primi et infimi gradus ad unionem naturæ," leading the mind "ad axiomata sublimia et nobilia."[§]

Nitre has always been an important salt; it was known in the East from very early times, and after the invention of gunpowder was largely imported into Europe. Geber, the earliest writer on chemistry (8th century), mentions both nitre and nitric acid, and the former figures prominently in all alchemical and old chemical treatises. It was called *saltpetre* from the fact of its being found adhering to rocks (πετρος). Bacon attributes the force of gunpowder to the nitre which it contains, "which having in it a notable, crude, and windy spirit, first by the heat of the fire suddenly dilateth itself, and we know simple air being preternaturally

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[*] "On the Difficulty of Preserving Flame without Air."

[†] Chemical News, vol. x., p. 208.

[‡] *Nov. Org.*, Lib. 2, Aph. 11.

[§] *Nov. Org.*, Lib. 2, Aph. 27.

attenuated by heat will make itself room, and break and blow up that which resisteth it; and secondly, when the nitre hath dilated itself, it bloweth abroad the flame, as an inward bellows."[‖]

Shortly after the establishment of the Royal Society, Mr. Henshaw (one of the first elected Fellows) read a paper before the Society "On the History of Nitre," [¶] in which he says it is probable "that the air is everywhere full of a volatile kind of nitre" generated in the clouds, inasmuch as he has found it in dew and rain. He was informed, however, that no earth yields so much as that of a churchyard, a fact which militated somewhat against his theory. He speaks of nitre as "the darling of nature, the very basis and generation of nutriment." In a history of nitre written by one William Clark, and published in 1670, we find a section with the rather startling title "A Chemical Analysis of Nitre;" nitre was heated in a retort with potters' earth, when red vapours, smelling like aquafortis, and known as "the flying dragon," were copiously evolved; an analysis, indeed, in the broadest sense of the word, but scarcely justifying the title of the chapter describing it; for we must remember that a hundred years later the term "chemical analysis" could not justly be applied to any operation or series of operations in the chemistry of the period. Clark considers that thunder, lightning, and meteors are caused by nitre in the air; Sennertus attributed thunder and lightning to the meeting of nitrous and sulphurous vapours—an idea evidently originating from the knowledge of the composition and properties of gunpowder. Clark attributes the propulsive force of gunpowder to the sudden conversion of the nitre it contains into air. He mentions the fact that nitre was used by chemists for converting some metals into calx, and he considers that metals become rusted when exposed to the air on account of the nitre which it contains. The latter part of Clark's history of nitre is devoted to the statement of some remarkably wild and useless speculations; in one chapter the author proposes, and endeavours to support the supposition, "That the fiery rain of brimstone and fire on Sodom and Gomorrah was lightning; and that nitre is expressed by the word fire."

Boyle, in a short essay entitled "*A fundamental experiment with nitre,*" mentions that he prepared pure nitre by crystallisation, melted it in a crucible, and threw red hot cinders into the molten mass until deflagration ceased; he then added "spirit of saltpetre" to the residue, and set aside to crystallise; the crystals were found to resemble saltpetre in every respect. He also prepared nitre by mixing "common potashes and aquafortis" and crystallising.

Although a certain relationship between the air and nitre was very generally admitted, philosophers were by no means agreed as to the form and character of that relationship. Some maintained that the effects produced by the air are due to its containing nitre, others that the effects produced by nitre are due to its containing air. Thus, Hobbes and others considered that nitre consists of "many orbs of salt filled with air;" Gassendus, in common with a large number of philosophers, maintained that particles of nitre are diffused throughout the atmosphere; while Hooke, in his ingenious and philosophical theory of combustion,[**] affirms that the portion of the air which renders it the solvent of combustible bodies, "is like, if not the very same, with that which is fixed in saltpetre."

It has always been a matter of regret to us that Hooke's theory of combustion has received so little attention at the hands of the scientific; it was only last year that M. Chevreul (an authority on matters relating to the air), wrote in the *Comptes Rendus*, "On doit a Stahl la premiere explication de la combustion."[††] The theory of Stahl, unsupported either by experiment or sound reasoning, cannot be compared with the theory of Hooke, based upon experimental results, and supported by just and accurate reasoning: Hooke clearly showed the part which air plays in combustion; Stahl adopted the phantasy phlogiston. Then as to priority, Hooke's theory was perfected when Stahl was in his cradle, and was published when he was four years old. Hooke's theory was neglected simply because it was so little known, and this was owing to the manner in which it was given to the world. Not published separately, it was not even designated a new theory of combustion; it forms part of an article on "charcoal or burnt vegetables" in the "Micrographia," a work in which we should scarcely look for a new theory of combustion, inasmuch as it professes to detail "some physiological descriptions of minute bodies made with magnifying glasses." Moreover, there is nothing to guide the reader to the subject, and without reading the whole book he would not be likely to meet with it, for it is buried in a mass of irrelevant matter. It is, I conceive, in the causes given above that we must seek for an explanation of the fact that one of the most original and complete theories, which has ever appeared in the history of science, was all but unknown in its own period, and has remained almost unnoticed down to the present day.

We have next to consider the important treatise "De sal-nitro et spiritu nitro-aëreo," of John Mayow; the first of the five great works on pneumatic chemistry which were published before the discovery of oxygen.

Chlorine Water.—It has long been known that in chlorine water exposed to air and light hydrochloric acid is formed. Millon has lately shown that some hypochlorous acid is also produced. More recently Barreswill has proved the formation of some perchloric acid under the same circumstances, which observation has been confirmed by Schmitt.—*L'Institute*, 1865, p. 231.

Preparation of Iodide of Potassium.—Fuchs places 100 parts of iodine in a porcelain dish with 260 parts of distilled water, and adds thereto 75 parts of pure carbonate of potash and 30 parts of iron filings. The mixture is well stirred together, and allowed to stand. The action proceeds slowly by itself, but is hastened by the application of heat. When the evolution of carbonic acid has ceased, the mixture is evaporated to dryness with continual stirring. It is better to allow the mixture to stand for some time in a lukewarm drying oven until all the iron is peroxidised, and then evaporate to dryness. The dried mass is then placed in an iron vessel and heated to a dull redness. The residue is then extracted with the smallest quantity of distilled water; the solution, which has usually an alkaline reaction, is then saturated with hydriodic acid, and set aside to crystallise.—*Dingler's Polytech. Journal*, Bd. 177, S. 251.

[‖] "Sylva Sylvarum. A Natural History in Ten Centuries." Cent. 1, par. 30.

[¶] Read August 14, 1661, and printed in Sprat's "History of the Royal Society."

[**] See the tenth of these papers, CHEMICAL NEWS for February 17, 1865.

[††] "Note historique sur les manieres diverses dont l'air a été envisagé dans ses relations avec la composition des corps." *Comptes Rendus* for December 12, 1864.

TECHNICAL CHEMISTRY.

Note on the Preparation of Alizarine, by J. WALLACE YOUNG.

HAVING been lately engaged making some alizarine, and after having tried various methods, I find that on a small scale the following process gives good results, and is readily performed.

Garancine of good quality is extracted with alcohol; the solution is distilled to recover excess of alcohol, and the residuum is carefully dried. A little of the extract so prepared is placed in a small porcelain basin, and over it is inverted a small beaker glass over the mouth of which a piece of filtering-paper has been tied. A very gentle heat is now applied to the basin, the extract soon fuses, and alizarine sublimes, and is condensed on the bibulous paper. The success of the process depends almost entirely on the proper application and regulation of the heat; for, if it be too great, the sublimation is conducted too hastily, and the product will invariably be contaminated or spoiled by an empyreumatic oil which is formed. But if the temperature has been properly regulated the alizarine will be found in magnificent orange red needles, often half an inch in length, adhering to the filtering-paper. If the heat has been very low, the crystals are often found resting immediately on the surface of the extract.

PHOTOGRAPHY.

Observations on Some New Compounds of Pyroxyline by JOHN SPILLER, *F.C.S.*

IN the *Comptes Rendus* of the Academy of Sciences, under date May 30, 1864, appeared an interesting communication from M. Blondeau, which was devoted to the description of some new ammoniated products of pyroxyline upon the examination of which, at about the same time, I happened also to be engaged in connexion with the investigation of gun-cotton, undertaken by Mr. Abel. The substances in question are formed whenever gun-cotton, or the soluble variety of pyroxyline, is exposed to the vapour of ammonia, and the chemical action facilitated by maintaining a slightly elevated degree of temperature. The operation is best performed on a small scale, by treating some forty or fifty grains of explosive cotton in a long-necked flask with aqueous ammonia (sp. gr. 880), added by successive portions of eight or ten drops, and the flask fitted with a very loose cork, immersed for an hour or two in a water bath kept at the temperature of 100° to 120° Fahr. The colour of the gun-cotton speedily changes to a light yellow, which gradually darkens to a russet brown, and its physical aspect undergoes a modification, to the extent of becoming a soft, friable mass, which still presents a fibrous appearance. By this treatment the explosive properties remain almost, if not quite, unimpaired; and it is worthy of mention that the production of this substance in large quantities is attended with risk, and that explosions have occurred in the course of my experiments whenever I increased the amount of material operated upon, or endeavoured to employ a somewhat higher temperature, in order to expedite the reaction.

M. Blondeau claims for his compound advantages on the score of greater permanence and superior explosive power, when compared with the varieties of gun-cotton which have lately been made the subject of experiment, with the view to their use in warfare. The author further states that the absorption of ammonia by the gun-cotton is accompanied by an increase in weight, notwithstanding the elimination of a certain amount of oxygen in the form of water. There are, he believes, several stages in the reaction, and he recognises particularly two bodies having the following formulæ:—

Nitro-cellulo-triamide, $C_{12}H_{10}O_{10}(NO_4)_3,(NH_2)_3$.
Nitro-cellulo-pentamide, $C_{24}H_{20}O_{20}(NO_4)_5,(NH_2)_5$.

It is not necessary for the present purpose to follow the author through the remainder of a series of interesting bodies derived from the first of these by the action of lead and potassium salts, or of sulphuretted hydrogen; but we cannot omit to refer to a statement which is embodied in a more recent communication to the French Academy, and is printed in the *Comptes Rendus* of the 28th August last. M. Blondeau remarks that he has succeeded in converting the ammoniated gun-cotton (the pentamide already referred to) into a kind of saline combination by treatment with hydrochloric acid; and, furthermore, that the same product may be obtained by boiling, for half an hour, gun-cotton in a tolerably strong solution of sal ammoniac, then washing in a plentiful supply of water, and drying in the sun. The formula of the compound thus formed is stated to be—

$$C_{24}H_{20}O_{20}(NO_4)_5,(NH_2)_5,(HCl)_5.$$

The substance is said to be permanent, and to resist decomposition at all temperatures not exceeding that of boiling water; it is equally explosive with, but gives off during combustion, certain products in addition to those furnished by ordinary gun-cotton, particularly cyanogen and the vapours of chloride of ammonia.

Conceiving this substance to be well fitted for the production of a collodion which, by the addition of nitrate of silver, would become at once available for the collodio-chloride process, I attempted its preparation in the hope that it might prove to be soluble in ether and alcohol. Failing, however, in the first attempt, I made repeated experiments upon several different varieties of gun-cotton (the exact quality of which the author omitted to specify), following to the letter the instructions given, but without being able in any instance to fix an appreciable quantity either of chlorine, or of the elements of amidogen. It is needless to observe that a mode of formation founded upon the successive production of the ammoniated and of the chlorinated compounds would be too tedious to permit its use in the practical direction already indicated.

Inasmuch as I could not perceive any alteration in the properties of the gun-cotton which had been boiled with solution of sal ammoniac, and failing in obtaining analytical proof of the existence of chlorine and amidogen, I proceeded next to compare the weight of the substances before and after treatment. In operating upon weighed portions of the highly-explosive tri-nitro-cellulose, and likewise of the inferior nitro-compound usually employed in the manufacture of collodion, I could not discover the slightest increase, nor indeed any alteration, in weight as the result of such treatment. The samples were, of course, thoroughly washed in many changes of distilled water (until nitrate of silver failed to show any indication of alkaline chloride yet remaining) and they were allowed to dry by free exposure to air. According to M. Blondeau's formulæ, which exhibit a constitution embracing a greater number of hydrogen and oxygen atoms than usually assigned by English chemists, the chlorinated product should weigh at least one-third more than the gun-cotton from which it is prepared, as will appear by the following comparison:—

	Pyroxyline.		Chlorinated product.
C_{24}	144	C_{24}	144
H_{20}	20	H_{20}	20
O_{20}	160	O_{20}	160
$5NO_5$	270	$5NO_4$	230
		$5NH_2$	80
	594	$5HCl$	182·5
			816·5

With respect to the yellow combinations obtained by the action of ammonia upon gun-cotton of various kinds, I find that they are all distinguished by their ready solubility in wood spirit, and in mixtures of ether and alcohol, but that alcohol alone is for them but an indifferent solvent. The solutions obtained do not offer any promise of being successfully employed as photographic collodion; firstly, on account of their objectionable colour; and, secondly, by reason of the opaque and pulverulent qualities of the film left on evaporation.—*Photographic News.*

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

November 28, 1865.

R. Angus Smith, *Ph.D., F.R.S., &c., President, in the Chair.*

Dr. Roberts drew attention to the injurious effects produced by burning Pharaoh's serpents in close rooms, and gave the particulars of a case which had lately come under his notice.

Dr. Roscoe stated that in his opinion persons could not be too careful respecting the inhaling of even small quantities of mercury vapour, and he alluded in support of his opinion to the fact that two German gentlemen who were engaged in a London laboratory, in the preparation, for a scientific purpose, of volatile organic mercury compounds, had recently been poisoned by the accidental absorption through the lungs or skin of very small quantities of the vapours of these substances. The symptoms characteristic of this form of mercurial poisoning are of the most painful and distressing kind, the first patient dying in a state of mania shortly after his admission into the hospital, and the second, on whom the effect became first perceptible three months after he had ceased to work with the substance, now lying in a hopeless state of idiocy.

A paper was read "*On the Amount of Carbonic Acid contained in the Air above the Irish Sea,*" by Mr. T. E. Thorpe, Assistant in the private Laboratory, Owen's College, communicated by Professor H. E. Roscoe, F.R.S.

The determination of the amount of carbonic acid contained in the atmosphere over the land has been made the subject of investigation by many experimenters, and from the results obtained by Theodore de Saussure, Brunner, Boussingault, Angus Smith, and others we are acquainted with the exact proportion of this gas contained in the atmosphere under varying circumstances of situation and weather.

But hitherto the influence which *à priori* must necessarily be exercised by large bodies of water on the proportion of carbonic acid in the atmosphere has scarcely been sufficiently studied. The fact that a considerable influence is exercised has certainly been noticed, but beyond the incomplete results of one or two observers, we have no numerical data from which to judge of the extent of this influence, and we therefore know but little of the changes in the comparative amount of the atmospheric carbonic acid as effected by the waters of the ocean.

Dr. Roscoe, therefore, suggested that I should undertake some experiments on this subject, and kindly placed the necessary time and apparatus at my disposal. I may here be allowed to express my thanks for his kindness, and for the advice I have received from him during the prosecution of these experiments.

It appeared from the observations of Vogel on the air of the Baltic and of the Channel that the sea abstracts to a very considerable extent the carbonic acid from the atmosphere; and this conclusion was apparently confirmed by the experiments of Emmet on the air over the Atlantic and at Bermuda, and by the determinations of Watson at Bolton, made on the air blowing from the seaward.

These experiments were, however, for the most part, merely qualitative, and the circumstances under which they were made, together with the inaccurate nature of the methods employed, render such a conclusion premature. In fact, the experiments of Lewy and Morren on the nature of the gases which sea water holds in solution at different periods of the day and during various seasons of the year would appear to show that the sea may possibly act in quite the opposite direction, and cause a sensible increase in the comparative amount of atmospheric carbonic acid.

The air contained in sea water consists of variable quantities of free carbonic acid, oxygen, and nitrogen, and Morren and Lewy have shown that the changes in the relative proportions of these gases depend—(1) upon alteration of temperature affecting the relative amounts of the dissolved gases in accordance with the laws of gaseous absorption; and (2) upon the variations in intensity of direct and diffused solar light, producing a corresponding effect upon the vitality of sea plants and animals, and hence altering the composition of the dissolved gases.

Some further experiments by Lewy, on the composition of the atmosphere above the Atlantic ocean in the tropics, tend to confirm the above supposition of the possible increase in carbonic acid in the atmosphere above the sea. In fact, if it is possible that the composition of the air above the sea in our latitudes can be sensibly altered by this phenomenon of the variation in the nature of the gases in solution in sea water, as Lewy and Morren assert, we might expect that the atmosphere above the tropical oceans would manifest to a much larger extent variations in the relative amounts of carbonic acid and oxygen, since infusoria exist, as is well known, in enormous quantities in these oceans, and the composition of the air in their waters must necessarily undergo rapid variation, and a considerable evolution of the dissolved gases must consequently occur. At the instance of the French Academy, Lewy collected air at different times during a voyage from Havre to Santa Marta, and on subsequent analysis not only did it appear that the mean quantity of carbonic acid was sensibly greater in the air of the Atlantic ocean in the tropics than in the air of the land, but also that the air of the day was appreciably richer in carbonic acid and oxygen than air collected in the night.

On comparing the means of each series we have, in 10,000 volumes of air, for the

	Day (mean of 7 experiments.)	Night (mean of 4 experiments.)
Carbonic acid	5·299	3·459
Oxygen	2105·801	2097·412

and this variation appeared to increase in proportion as the middle of the ocean was approached.

This remarkable phenomenon, of the variation in composition of the air above the tropical oceans, may doubtless be accounted for, without any reference to the direct action of infusoria, by the heating effect of the sun on the sea water and the consequent disengagement during the day of gas proportionately rich in carbonic acid and oxygen. During the night, on the other hand, as this source of action is removed, the disengagement may be assumed not to occur; and, following Lewy, one may perceive that this difference would become more appreciable and easier to trace in air at great distances from any continent than in air collected nearer the coasts, and, consequently, liable to be mixed with the air of the land.

Although the precision of these results is certainly remarkable, they still require confirmation. The air was collected in glass tubes of about 100 c.c., and analysed eighteen or twenty months after in the eudiometric apparatus of Regnault and Reiset. The fact pointed out by Regnault that air which has remained for any great length of time in glass tubes invariably exhibits notable diminutions in the amount of carbonic acid, since the glass absorbs a portion of this gas; and the difficulty generally experienced in accurately noting contractions so minute as the absorption of the carbonic acid from a small volume of atmospheric air, are circumstances which may possibly influence the reliability of the results.

The kind permission of the Honourable Board of Trinity House has enabled me during the vacation of last summer to make some additional experiments in this direction on board the *Bahama Bank* Light-vessel, situated in the Irish sea, latitude 54° 21′ and longitude 4° 11′, seven miles W.N.W. of Ramsey, Isle of Man, and consequently nearly equidistant from the nearest shores of England, Scotland, and Ireland. The ship is placed to mark the proximity of a dangerous bank, by which, for the greater part of the day, a strong current, setting in from the southward, flows through the North Channel and thence into the Atlantic.

These experiments were made in the early part of August, at the same periods of the twenty-four hours—namely, about 4 a.m. and 4 p.m., or nearly the times of minimum and maximum temperature.

Pettenkofer's method of analysis was adopted, with the improvements in the practical details suggested by Angus Smith. This method is in principle similar to the one adopted by Watson and Emmet, but admits of far more delicacy and precision in practice. Baryta is substituted for lime water, and oxalic for sulphuric acid. The solution of oxalic acid for these experiments was made so that one cubic centimetre of it corresponded to one milligramme of carbonic acid; it thus contained 2·864 grms. of pure crystallised oxalic acid per litre. Twenty-five cubic centimetres of the baryta solution were originally made to correspond to about twenty-eight of oxalic acid; but, of course, the exact strength of the baryta water was ascertained previous to each experiment. The bottles were generally filled with the air by means of the bellows; but sometimes when the wind was strong it sufficed to hold them up for a minute or two in such a manner that the air could circulate freely within. The baryta water remained in contact with the enclosed air for three-quarters of an hour to one hour, during which time the bottles were frequently agitated. Although even this is longer, perhaps, than is actually required for the complete absorption of the carbonic acid, still, for the sake of conclusiveness, in experiment 4 the bottles were allowed to stand for three hours, and in experiment 13 for six hours, before the solutions were tested. The capacities of the two bottles which served for all the experiments were 4815 c.c. and 4960 c.c. The burette was Mohr's modification, for which a table of calibration had been constructed by weighing and interpolating in the ordinary way.

The fact that the various meteorological changes influence to such a remarkable extent the nature and amount of the gases dissolved in sea-water renders it necessary, in any investigation on the constitution of the atmosphere over the sea, to take particular account of these changes. Accordingly the temperature, pressure, and degree of humidity of the air; direction and force (estimated—Beaufort's system) of wind); amount (estimated—overcast = 10) and nature of clouds, and general appearance of the day, together with the temperature of the sea-water and amount of sea disturbance (1 to 9), were noted at the time of each experiment.

The following table shows the results of these observations, together with the amount, in volumes, of the carbonic acid in 10,000 volumes of air. All the experiments which were made are here given. The hours of observation, as before stated, were 4 a.m. and 4 p.m.:—

TABLE OF RESULTS.

No.	Aug. 1865.	Night or Day.	Bar. Mm.	Temp. of Air.		Temp. of Sea.	Direction and Force of Wind.	Sea Distr. (1 to 9)	Amount and Nature of Clouds. (Overcast = 10.)		Carb. Acid.		Remarks.
				D. Bulb.	W. Bulb.						1 Ex.	2 Ex.	
1	4th	D.	762·5	16·4°C.	11·1°C.	16·0°C.	N.W. by W. v. lt.	calm	cirrus	1	2·66	3·07	Day v. fine & cl.
2	4th	N.	762·0	13·9	12·9	15·0	S.W. by S. lt. br.	1	cirro-cumuli	9	2·92	3·05	
3	5th	D.	761·2	16·1	14·4	15·0	S.W. by S. lt. br.	1	cirro-cumuli	9	3·08	3·21	Not much sun.
4	6th	N.	753·4	14·2	13·3	15·0	S.W. by W. lt.	1	cirro-cumuli	9	3·30	3·22	Bryt. wtr. exp. 3h
5	7th	D.	757·5	17·2	15·1	15·6	N.W. light.	1	cirro-cumuli	6	3·20	3·15	Sunny, v. fine.
6	7th	N.	760.2	13·6	12·2	15·0	N.N.W. mod.	3	cirro-cumuli	8	3·06	3·19	
7	8th	D.	761·0	18·3	13·1	16·0	N.N.W. lt. br.	1	cirrus	1	3·32	3·02	Fine and sunny.
8	8th	N.	758·7	13·3	12·2	15·0	S.W. by W. lt. br	1	cirrus	7	2·93	3·10	
9	9th	D.	756·4	15·0	—	15·0	S. by W. mod.	1	cirro-cumuli	7	3·09	2·23	Rain. [day.
10	10th	D.	749·3	15·0	13·9	14·5	S. by W. fresh	4	nimbus	9	3·11	3·11	V. wet, rain all
11	11th	N.	750·5	13·4	11·9	14·5	S.W. by W. str.	5	nim. & cirro-cum.	7	3·09	3·10	} V. windy much
12	16th	D.	652·3	14·7	12·8	15·0	N.W. by W. lt.	2	cirro-stratus	8	2·93	2·95	} rain fr. 11-16.
13	16th	N.	753·1	13·9	12·8	15·0	W.S.W. fresh	4	cirro-stratus	9	3·12	2·94	Byrt. wtr. exp. 6h

Day mean of 14 determinations . . . . . . 3·086
Night " 12 " . . . . . . 3·085

In comparing these results with the following determination of the carbonic acid contained in land air, it is seen that the air of the Irish Sea contains a much smaller proportion of carbonic acid than in the air of the neighbouring land. The most extensive observations on the land air have given as means:—

Observer.	Locality.	No. of Expts.	Vols. in 10,000 of air.
Th. de Saussure	Chambeisy,	104	4·15
Boussingault,	Paris,	142	3·97
Verver,	Groningen,	90	4·20
Roscoe, 1st series,	London & Manchester,	108	3·97
" 2nd "	Manchester,	53	3·92
Smith,	"	200	4·03
	General mean of land air,		4·04
	Mean of 26 expts. on sea air		3·086

It would also appear that no difference is discernible in the amount of carbonic acid in the air of day and night over the Irish Sea. On the other hand, from Saussure's observations, a decided difference may be traced between day and night air on the land—a conclusion subsequently confirmed by several experimenters.

In noting the above mean 3·08, and the apparent identity in the amount of carbonic acid in the air of day and night over the sea, it should be borne in mind that July and August are, in general, the hottest periods of the year (these months were unusually hot this year, 1865), and that, consequently, all the influences may be supposed at work which would tend to increase the relative amount of carbonic acid, and render appreciable any difference in the air of night and day.

The conclusions therefore to be drawn from these experiments are:—

1. That the influence of the sea in our latitudes in abstracting the carbonic acid from the atmosphere is not so great as the old experiments of Vogel and others would lead us to suppose.

2. That the sea in our latitudes does not act in increasing the amount of carbonic acid in the air above the ocean, as found by Lewy over the Atlantic near the equator.

3. That the differences observed in the air of night and day by Lewy on the Atlantic are not perceptible in the air above the Irish Sea.

4. That in the month of August, 1865, the mean quantity of carbonic acid in the atmosphere of the Irish Sea was 3·08 in 10,000 volumes of air.

In conclusion, I beg to acknowledge the kind attention which I received from Captain Temple and from his crew during my stay on board his ship.

PHARMACEUTICAL SOCIETY.

Wednesday Evening, December 6.

Mr. Hills, *Vice-President, in the Chair.*

After the usual preliminary business, Mr. Squire called the attention of the Society to "*Cod Liver Extract.*" He had brought with him the extract resulting from the evaporation of the water which oozes out of the cod's liver when extracting the oil. He finds that on the average 28lbs. of large and fresh livers yield 12lbs. of oil and 1lb. of water; this evaporated yields 2 oz. of extract. 5 grs. of the extract, when purified, is stated by Messrs. Barr and Co. to be equal to a tablespoonful of cod liver oil. It was this startling announcement that induced him to have the water collected and evaporated, in order that the members of the Society might examine the product and judge for themselves, and if it was thought worth while to have it analysed in their laboratory. He thought it was highly important for us to know whether or not that we were throwing away so valuable a nutrient as these gentlemen state it is.

A gentleman who attended for Messrs. Barr and Co. explained that the cod liver extract was in no wise a secret or quack remedy. The method by which it was prepared, he said, had been patented, and he read the specification of the first of the two patents taken out by the proprietors.

Mr. Squire wished to know how the value of the extract was estimated, so as to compare it with the value of the cod liver oil.

It was explained in reply that the amount of extractive and inorganic matters yielded by a given amount of the oil, and supposed to be the same as those contained in the extract, give the means of determining the relative value of the oil and extract.

Dr. Attfield said that he would not shrink from making the analysis suggested by Mr. Squire; but he thought the question one on which chemistry could throw but little light. It was a matter for physicians, who observed the effects of medicines, to decide.

Mr. Deane thought it was no business of the Pharmaceutical Society to take up the analysis of proprietary medicines. If one was alleged to be poisonous or dangerous, it was another matter; but in general it was no part of the Society's business to expose nostrums.

Mr. Squire replied that he had no wish to expose nostrums. In the present case it was asserted that this extract, which was usually thrown away, was much superior to the oil which was preserved, and he thought it of importance to establish the truth or falsehood of this assertion.

Dr. Edwards contended that the discussion was one which the Society could not enter upon. They could not decide upon the therapeutic value of a medicine.

The Chairman suggested that Mr. Squire should induce a medical friend to make some experiments with the extract, and report the results to the Society.

Mr. Barr (?) said that the extract itself was sold to druggists or medical men, who could use it in whatever form they pleased. Under the first patent, he might explain, only the aqueous extract was used, but under the second this extract was treated with alcohol and ether, and all the extracts (so we understood) were used together.

The subject was then dropped.

Dr. Attfield read a note from Mr. Groves, who claimed to have first made known, in a communication to the Pharmaceutical Conference on the "*Rancidity of Fats,*" the fact that some essential oils, especially those of pimento and cloves, prevent ointments from becoming rancid.

Mr. Reynolds exhibited some models of fungi of German manufacture.

The Chairman expressed an opinion that a set should be purchased for the Society's museum.

Professor Bentley called attention to specimens of Victorian products lately exhibited at the Dublin Exhibition, and now presented to the Society. Among them was some of the oil of the Eucalyptus odorata, now imported into this country in considerable quantities, and used to scent soaps.

Dr. Attfield then read a long communication "*On the Physics of Filtration,*" a report of which we are obliged to defer.

ACADEMY OF SCIENCES.

December 11, 1865.

Several communications on the subject of "*Cholera*" were read. We need only mention that by M. Rezard de Wouves "*On the Diagnosis of Cholera by the Presence of Albumen in the Urine of the Patient at the Commencement of the Malady.*" The presence of albumen in the urine is regarded by the author as the one characteristic and distinguishing symptom between simple diarrhœa and true cholera.

M. Nickles presented a note "*On a New Character Distinctive between Cane Sugar and Glucose.*" The behaviour of cane sugar and glucose, when heated with bichloride of carbon, is as different as black from white. In other words, cane sugar sealed in a tube with the bichloride and heated for some time to about 100° C., soon turns black; while glucose, under the same circumstances, keeps its colour. Although the bichloride of carbon alone is not decomposable at a temperature of 98°, the author believes that in this experiment a decomposition takes place, chlorine being set free in the first instance, and passing subsequently to the state of hydrochloric acid by its action on the organic matter. That chlorine is formed first, and then hydrochloric acid, the author considers is proved by the following experiments:—In one tube, dry glucose and bichloride of carbon are sealed; in another, dry tartaric acid and bichloride of carbon; in a third, a mixture of dry tartaric acid and dry glucose, and bichloride of carbon. All three tubes are then heated in a steam bath. In the first two tubes no action is observed; in the third, the mixture is seen to swell up and turn brown, and on opening it the tube is found to contain free chlorine. The explanation of this appears to be that the decomposition of the bichloride is determined by the elements of water separated during the production of the gluco-tartaric acid.

M. Caron, in a note, announced his "*Discovery of Niobium and Tantalum in the Tin Ore of Montebras*" (Creuse) to the extent of some 2 or 3 per cent. of the mineral.

M. E. Kopp communicated an account of the "*Chemical Examination of some Ornaments Found in a Celtic Tomb.*" He gives the analyses of two rings, composed chiefly of tin and copper, and of a third ring, which seems to have been made of some very bituminous or resinous fossil wood.

M. Houzeau addressed a short note on "*Ozone.*" He is very unwilling to believe that his paper will not really detect ozone in the atmosphere, while he admits that it gives no decisive proof of the presence. He agrees with M. Frémy that such decisive proof is wanting; but he still believes in the existence of atmospheric ozone.

M. Payen replied to the note of M. Personne last week, and claimed the first publication of the explanation of the decolouration of iodide of starch by heat in 1843. M. Personne made his communication on the subject in 1861.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

2952. R. Jones, Botolph Lane, London, "Improvements in preserving animal and vegetable substances, and in means or apparatus employed therein."—Petition recorded Nov. 16, 1865.

3042. W. R. Lake, Southampton Buildings, Chancery Lane, "An improved composition for enamel, paint, varnish, cement, or plaster."—A communication from W. B. Watkins, New York, U.S.A.—Nov. 27, 1865.

3071. W. Thompson, Lower Gardiner Street, Dublin, "Improvements in fining, purifying, and mellowing spirituous liquors, by combining therewith other substances for the production of a new spirituous or vinous compound therefrom."

3075. J. Gamgee, Bayswater, Middlesex, "Improvements in disinfecting stables and cattle sheds, and in the apparatus employed therein."—Nov. 30, 1865.

3095. E. D. Wilson, Edinburgh, "Improvements in furnaces."

3101. I. N. Bennie, Gowan, Lanarkshire, "Improvements in apparatus for distilling oils and condensing oily vapours."—Dec. 2, 1865.

3109. W. Beardmore, Parkhead, Lanarkshire, "Certain improvements in the construction of forge furnaces."

3111. A. Paraf and R. S. Dale, Manchester, "A new colouring matter for producing scarlet colours upon woven fabrics and yarns."

3115. J. Tomlinson, Eden Mount, Carlisle, "Improvements in the manufacture of disinfectants."—Dec. 4, 1865.

3119. R. A. Brooman, Fleet Street, London, "A new or improved cement or composition applicable to the agglomeration or moulding of various materials, and to other useful and decorative purposes." A communication from S. Sorel and E. J. Menier, Paris.—Dec. 5, 1865.

Notices to Proceed.

1936. W. Richards and J. Richards, Oldbury, Worcestershire, "Certain improvements in the manufacture of sal ammoniac."—Petition recorded July 26, 1865.

1964. E. Sabel, Moorgate Street, London, "Improvements in the manufacture of iron and steel." A communication from M. D. Henvaux, Saint Servais, near Namur, Belgium.—July 29, 1865.

2015. E. L. Ransome, Ipswich, Suffolk, "Improvements in paints or preparations for coating surfaces.—August 3, 1865.

2105. J. F. Boetius, Smethwick, Staffordshire, "Improvements in furnaces to be used in the manufacture of glass, and iron, and steel, and for other like purposes." A communication from H. Boetius, Schaunstein, near Obernkirchen, Germany.—August 15, 1865.

2219. H. Terrell, Basinghall Street, London, and T. Dow, Alpha Road, New Cross, Kent, "Improvements in the method of and apparatus for treating peat and other plastic materials."—August 29, 1865.

2482. C. H. L. Wintzer, Osnabrück, Hanover, "Improvements in separating phosphorus from iron and other metals in metallurgical processes."—September 27, 1865.

2870. F. Prange, Liverpool, "Improvements in the manufacture of steel." A communication from J. Rosenthal and F. Gierow, Berlin, Prussia.—November 7, 1865.

2964. W. E. Newton, Chancery Lane, "An improved process for hardening malleable and non-malleable cast iron." A communication from T. H. Jenkins, New York, U.S.A.—November 17, 1865.

2187. C. A. Watkins, Greek Street, Westminster, "Improvements in apparatus for supplying carbonic acid gas to casks and other vessels from which beer, wine, and other fermented liquors are drawn."—Aug. 25, 1865.

2682. W. Beardmore, Parkhead, Lanarkshire, "Improvements in furnaces."—Oct. 17, 1865.

3025. W. A. Lyttle, General Post Office, London, "Improvements in furnaces."—Nov. 25, 1865.

CORRESPONDENCE.

New Cornish Minerals.

To the Editor of the Chemical News.

Sir,—Hard work may bring its own reward, but it sometimes brings other things which are not very nice. On the whole it is better not to labour overmuch. To analyse and describe a really new and interesting mineral is, it seems, an unwarrantable liberty for a chemist to take. To analyse and describe several new minerals is more than a mistake; it may even amount to a crime, if the wretched chemist chance to speak of the crystallography of any of his new species. Most chemists, however, do not commit this offence; they are generally content with the safe, though vague, expressions "the substance crystallises in delicate tufts of needles;" or, "in hard and lustrous prisms." But I must now describe my own offence, and try to show that I have not been so very wicked after all.

In the Chemical News of September 15 I gave a brief note on a new phosphate of cerium. Shortly afterwards Mr. Greville Williams established the presence of didymium in the mineral, and was good enough to name it Churchite. But before this occurred, I had sent to the Chemical Society my full memoir on three new mineral species from Cornwall, cerous phosphate being fully described therein. My paper should have been read at the first meeting of the present session of the Chemical Society, had not the Secretary accidentally mislaid it. So, at five minutes' notice, I gave a lame account of my chief results. Afterwards, Professor Maskelyne, although he did not accept my opinion as to the crystalline form of the new mineral, yet spoke of the interest attached to my discovery, in courteous and congratulatory terms. But a change has now taken place. Professor Maskelyne now speaks of me as "the chemist who introduced the mineral;" how elegant a way of avoiding the suggestion of "Mr. Church's discovery!"—and thinks that it would have been well if I had adopted in my paper the diffident tone with which he credits my speech before the Chemical Society. Professor Maskelyne further says "there are no grounds whatever at present for calling the mineral oblique," &c. In answer to this statement, I beg to say that my paper is essentially chemical, and is so entitled; that the attempted description of the crystalline form of the species is confessedly imperfect, and is prefaced by the modifying words "It would appear," &c.; and that my opinion thus doubtfully expressed was not formed hastily, but after numerous angular measurements, and after careful study of the cleavages. For these purposes my specimen must be far more suitable than the specimens which Professor Maskelyne possesses, and which, he says, are in every respect inferior.

Professor Miller, of Cambridge, was good enough to inform me that from a small fragment which I forwarded to him he had not been able to detach a crystal so as to obtain the necessary reflexion. I stated this at the Society's meeting; I did not say that Professor Miller "could not meet with any angles good enough for measurement."

As to the fancied resemblance of Churchite to Wavellite, I never mistook the former for the latter. Had I been under this impression, I should not have been so glad to secure the curious fragment, nor so eager to investigate its chemical composition.

Professor Maskelyne very justly complains of the want of a laboratory at the British Museum. But when Mr. Talling sent the new mineral to the Museum on approbation, might not Professor Maskelyne have tried a blowpipe experiment with it at home? Thus he might have saved me the labour of investigating, as far as I could, all the chief physical and chemical features of this new mineral, of which, I confess, I am now very fond; thus, also, I should have been spared the trouble of writing this reply.

I wait for Professor Maskelyne's promised crystallographic determination of my new phosphate of cerium. I am sorry he did not accept my offer to lend him my own specimen. I am, &c. A. H. Church.

Cirencester, December 18.

"*Associate of the Royal School of Mines.*"

To the Editor of the Chemical News.

Sir,—The reply of the Registrar of the Royal School of Mines to the inquiry I ventured to make is complete and to the point. It is satisfactory to know that this title of "Associate of the Royal School of Mines" is warranted by recognised authority, and conferred with the sanction of a representative of the Crown. The knowledge that the title is thus bestowed must tend to enhance its value in general estimation. I am, &c.

J. Denham Smith.

December 11.

Removal of Bisulphide of Carbon from Coal Gas.

To the Editor of the Chemical News.

Sir,—Your notice at page 277 of the Chemical News for December 8 respecting the results obtained in my experiments upon the removal of bisulphide of carbon from coal gas by "scrubbing" with ammoniacal liquor of gas works is not quite correct, and you will oblige by allowing me to give some explanation.

You remark that my results are not equal to those obtained by others, and you mention it had been found that nine-tenths of the sulphur compounds is removed at the Nottingham Gas Works. In the summer of this year I found that all the bisulphide of carbon and such allied sulphur compounds, could be taken out of the gas without difficulty in this way; and some experiments conclusively proving this were published in the *Journal of Gas Lighting* for September 5 last, in reference to which a leading article in the same number I now quote from says: "The means by which Professor Anderson has succeeded in completely purifying coal gas from sulphur in any form is by repeated and copious washing with sulphide of ammonium."

I have heard that experiments have been made upon the same points at Nottingham; but as they have not been published until my own papers appeared in the *Journal of Gas Lighting*, gas companies have been, I believe, without much information upon this subject. It is also within my recollection that the Corporation of the City of London some fifteen months ago appointed a scientific commission to investigate the matter; but it does not appear that they have yet reported thereupon. The indifference manifested by the metropolitan companies to this simple mode of purifying their gas from these troublesome sulphur compounds and ammonia, with correlative improvement in illuminating power, whilst not unprecedented in manufacturing annals, is certainly unique in its way. Thus they have been for a long time past constantly censured by the examining chemist to the Corporation for violating the Act of Parliament regarding the purity of their gas, until they have at last provoked the formation of a new company, backed by the Corporation itself, with, at the same time, a sort of waste product of their manufacture, generated in their own works, crying out, as it were, "Why will you not let me purify your gas?"

I am, &c.
Alfred George Anderson,
Professor of Chemistry in Queen's College,
Birmingham.

December 12, 1865.

Composition of Rice.

To the Editor of the Chemical News.

Sir,—The results of the analysis of fourteen samples of East Indian rice will probably interest some of your readers:—

		Greatest variation in.
Starch and fibre	79·48	4·45
Gluten	6·02	2·00
Sugar and gum	3·09	2·20
Water	11·63	3·00
	100·22	

They comprised varieties of Bengal, Madras, Java, Siam, Rangoon, Moulmein, and Arracan.

I am, &c. R. Ransford.

Brompton, December 18.

MISCELLANEOUS.

Royal Institution of Great Britain.—The following are the lectures for the ensuing week:—Tuesday, Dec. 26, Thursday, Dec. 28, and Saturday, Dec. 30, 3 o'clock, Professor Tyndall, "On Sound" (juvenile lectures).

Suicide of Storer.—This young man, who, it will be remembered, was assistant to a surgeon at Salisbury, whose daughter he was accused of poisoning by strychnia, committed suicide in Fisherton Gaol. From a letter he left behind him, it appears that he prescribed some pills for the young lady, each of which contained ⅛th of a grain of strychnia—a dangerous dose, which could only have been ordered by a rash or ignorant prescriber. The young lady was directed to take but one at a time. She probably took four at once, or at short intervals, and death was the result.

How it Ought (?) to be Taught that Fat is Formed in the Body.—"Let him teach that *the hydrogens are* generated to a large amount in the system from the fat taken, and consequently absorb oxygen freely, the natural results being *aqueous elements, which become inspissated, and fatty deposits are the result.* When there is a diminished supply of oxygen to the intestines, with a full supply of hydrogen, then greater quantities of fat necessarily ensue. But let them give up the idea that eating fat itself, or fat-producing elements, supply fat *per se,* for they do no such thing. This can only be done in the way I have previously said, by their conversion into hydrogens, and then combining with oxygen; and if this is not done many persons, to my own knowledge, who are great consumers of fat, never made fat nor carried fat themselves in any like proportion."—*Writer in a Medical Journal.*

Analyses of London Waters.—Analysis of the metropolitan waters in October, 1865, by Professor Frankland, F.R.S., of the Royal College of Chemistry :—

Names of Water Companies.	Solid matter in 100,000 parts of the waters.	Organic and other volatile matter.	Amount of oxygen required for oxidation of organic matter.	Degrees of Hardness.[*]		
				Permanent.	Temporary.	Total.
Thames Water Companies.						
Chelsea	24·98	1·83	·1606	6·7	7·8	14·5
West Middlesex	25·30	1·96	·1076	6·4	11·1	17·5
Southwark and Vauxhall	29·32	2·32	·1521	8·2	9·5	17·7
Grand Junction	26·99	1·67	·0943	6·8	11·0	17·8
Lambeth	22·76	2·17	·1950	7·6	5·4	13·0
Other Companies.						
Kent	38·08	1·04	·0156	9·7	17·7	27·4
New River	27·59	0·73	·0421	5·5	15·6	21·1
East London	29·14	2·42	·1341	9·0	13·2	22·2
South Essex	40·54	1·44	·0140	8·2	18·3	26·5

The table may be read thus—100,000 lbs. of the Chelsea water contained 24·98 lbs. of solid matter, of which 1·83 lbs. of organic and other matters were driven off by incineration. ·1606 lbs. of oxygen were required to destroy organic matter in the said quantity of Chelsea water. Of the solid matter 14·5 lbs. are carbonate of lime or its equivalent; of which 7·8 lbs. are got rid of by boiling, and 6·7 lbs remain.

Dr. Whitmore's Report on the quality of the water supplied in St. Marylebone in November, 1865 :—

November.	Total solid matter in degrees or grains per imperial gallon.		Organic matter in degrees of grains per imperial gallon.		Ammonia.
	Nov. 1864.	Nov. 1865.	Nov. 1864.	Nov. 1865.	
Distilled Water	0°	0°	0°	0°	·0
W. Middlesex water	17·46	21·20	2·12	1·92	..
Grand Junc. water	17·44	21·68	2·0	1·96	..
Pump, Princes St., Oxford Street	Jan., 1865. 68·96	38·08	Jan., 1865 6·56	2·88	·848
Pump, Newman St., Oxford Street	..	88·80	..	5·92	1·056

As might have been expected from the late heavy rains, the quantity of organic matter contained in the Thames companies' water during the past month has been greater than in the month preceding; but, considering that this impurity must necessarily, for the most part, be vegetable, the deterioration of the water is of less importance than if it were produced by animal matter. The boasted superiority of the water from Loch Katrine for drinking purposes, which is found to contain no organic matter, and not more than two or three grains of inorganic, and which now supplies the city of Glasgow, has to be proved by the test of time. There can be no doubt that any amount of organic matter in the water we drink, however small, especially animal, is objectionable; but as regards the mineral constituents found in the rivers and wells in and near London, of which salts of lime constitute a large proportion, it is a subject well worthy of consideration to determine whether such water as this does not contribute to supply the earthy matter which gives solidity and hardness to the bony structure of the human frame; for, if not, it seems difficult to tell from what else in our daily sustenance it is derived.

Essence of Cognac and of Wine.—This is a mixture of several ethers of the ethylic series, but of which the special odour is that of pelargonic ether. The essences may be prepared in two ways: the first gives nearly pure pelargonic ether; the other, mixtures of very variable composition, and apparently inferior in quality. By the first method, pelargonic acid is obtained by treating oil of rue by nitric acid; to etherise pelargonic acid, dissolve it in concentrated alcohol, and pass into the mixture a current of dry hydrochloric acid; the pelargonic ether rises to the surface as it forms. By the second method, a fatty body is treated by nitric acid, and fixed fatty acids are produced, such as adipic, pimelic, lauric, succinic, &c., and also volatile acids, which may be distilled, and of which the chief are butyric, valerianic, capric, caproic, caprylic, œnanthylic, and pelargonic. This is the mixture which is to be etherised. Alcohol is sometimes scented with the product obtained by etherising cocinic acid, extracted from cocoa-nut oil; to obtain this acid, saponify cocoa-nut oil by potash, decompose the soap by hydrochloric acid, dissolve the acid thus obtained in alcohol, and pass into it a current of dry hydrochloric acid; a yellowish liquid will be the result; wash it with water and with alkaline water, when pure cocinic ether will remain, which mix with ten times its volume of alcohol. The richness of commercial essences in pure essences may be ascertained by distillation; alcohol boils between 80° and 85°, and the essences remain as residue. Artificial essences are not generally used in perfumery, excepting essence of mirbane; but other agreeably-scented essences will very probably be some day used, carefully combined and considerably diluted. As found in commerce, they have an odour which is far from agreeable, and they, moreover, have an injurious effect on the animal economy when inhaled in sufficient quantity; they must then, if used, be used sparingly.—*Des Odeurs, des Parfums, et des Cosmetiques.*

Illuminating Gas from Apples.—A new use for the marc from the cider presses has been discovered by MM. Gouverneur, Butler, and Eichebrenner, who submit it to dry distillation, and so obtain acetic acid, tar, and a large amount of gas of fair illuminating power.—*Resumé Oral, &c., par M. L'Abbé Moigno.*

Use of Ultramarine in Refined Sugar.—M. Monier writes to *Les Mondes* that the use of indigo, referred to in the Chemical News some time ago, has long been given up, and ultramarine is now employed. For a boiling of 800 loaves, weighing on the average 10 kilogrammes each, about 40 grammes of ultramarine is sufficient. This quantity, which gives about 6 centigrammes to a loaf, is enough to communicate the very slight blue tint required. Ultramarine is perfectly innoxious.

ANSWERS TO CORRESPONDENTS.

⁂ All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. *Private* letters for the Editor must be so marked.

⁂ In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. XI. of the Chemical News, containing a copious Index, is now ready, price 11s. 0d., by post, 11s. 6d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. XII. commenced on July 7, 1865, and will be complete in 26 numbers.

Derby.—Bunsen and Kirchoff, translated by Dr. Roscoe, but the latest discoveries are not contained.

H. M.—A constant stream of ozonised air can be obtained by means of the apparatus described at page 11, vol. x., of the Chemical News.

Clericus.—We do not remember to have met with any account of the experiments.

Copying Ink.—Sugar candy, an ounce; rich black ink, one and a-half pints; red ink, cochineal, oxalic acid, and gum arabic.

Vesuvians are made of nitre and charcoal tipped with the usual phosphorus paste; or of nitre, oxysulphuret of antimony, and [illegible], tipped as before.

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[*] The degree of hardness hitherto employed by chemists is that first proposed by Dr. T. Clark—viz., one grain of carbonate of lime, or its equivalent, in one imperial gallon of water, or one part in 70,000. The degrees of hardness used in the above table are readily converted into Clark's degrees by multiplying by 7, and then moving the decimal point one place to the left.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Action of Carbonic Oxide on Sodium-Ethyl, *by* J. Alfred Wanklyn.

The action of carbonic oxide on sodium-ethyl is of a very remarkable character. Carbonic oxide drives out sodium and gives a compound of carbonic oxide with ethyl. The following equation represents the change:—

$$CO + 2NaC_2H_5 = Na_2 + CO(C_2H_5)_2.$$

The product $CO(C_2H_5)_2$ is the ketone, ethyl-propionyl. A detailed account of the research will be published in the *Journal* of the Chemical Society.

London Institution, December 27, 1865.

TECHNICAL CHEMISTRY.

On the Manufacture of Commercial Carbonate of Ammonia, by J. Carter Bell, *F.C.S., Associate of the Royal School of Mines.*

This salt must have been known even to the alchemists, as it forms one of the chief constituents of putrid urine, but there seems to be no evidence that it was manufactured previously to this century; indeed, one would hardly think that they knew the difference between ammonia and its carbonate. The real difference was first pointed out by Dr. Black, of Edinburgh.

Carbonate of ammonia is formed by the putrefaction of animal substances, and by the destructive distillation of animal matter.

In the destructive distillation of bones, carbonate of ammonia is produced, and also water with the oil called "Dippel's oil," with some incondensible gases. The condensed liquors from the carbonisation of the bones are separated into two distinct states—the oily and the aqueous products—the latter containing the carbonate of ammonia; the salt can be separated by sublimation.

Many processes have been tried for the manufacture of this compound. I am informed by Mr. John Hogarth (who has been engaged in this chemical operation for forty years) that in the year 1825 a Mr. Holmes manufactured this salt in the old Haymarket, Liverpool; it was made from stale urine, and the resulting blocks were very small, weighing about six pounds. At the present time the weight of a block is about two hundredweight.

On March 11, 1844, Dr. Wilton Turner took out a patent for obtaining salts of ammonia from guano. The guano is subjected to destructive distillation in close vessels at a low red heat during the greater part of the operation, but the temperature is increased towards the end. The products of distillation are collected in a series of Woulfe's bottles, by means of which the gases evolved during the operation may be made to pass two or three times through water before escaping into the air. The products consist of carbonate of ammonia, hydrocyanic acid, and carburetted hydrogen; the first and second are rapidly absorbed by the water, with the formation of a strong solution of hydrocyanate and carbonate of ammonia.

In 1849 Mr. Hills took out a patent for obtaining carbonate of ammonia from guano. To effect this the guano is first mixed with charcoal or powdered coke; the mixture is then heated, and the carbonate obtained by sublimation. Peat has been experimented on for the production of this salt; whether it will be an economical process remains to be proved. Mr. Hills took out a patent for obtaining ammonia from peat, and Mr. Rees Reece in 1849 also had a patent very much like Mr. Hills'. The first part of the patent is for an invention for causing peat to be burned in a furnace by the aid of a blast, so as to obtain inflammable gases, tarry and other products. The tarry products may be employed to obtain paraffine and oils for lubricating machinery, &c., and the other products may be made available for evolving ammonia, wood spirit, and other matters by any of the existing processes. On July 27, 1849, a statement was made in the House of Commons to the effect that 100 tons of peat would produce 2602 pounds of carbonate of ammonia.

In 1841 Mr. Laming took out a patent for manufacturing carbonate of ammonia by mixing its separate acid and alkaline constituent, instead of by the decomposition of ammoniacal salt. One of the processes used is to cause ammonia and carbonic acid gas obtained separately from any convenient sources to traverse a succession of leaden chambers maintained at as cool a temperature as may be conveniently practicable, and so continued as to favour the admixture of the dissimilar gases. In this process it is not essential that the two gases be present in their combining proportions; it is preferable that the carbonic acid be in greater abundance than will combine with the ammonia which is present. Sometimes a stratum of water, or of water impregnated with ammonia, is placed in one or more of the leaden chambers. Carbonic acid and ammonia in the form of gas are then introduced; in which case, it is stated, a larger proportion of carbonic acid gas is found in the resulting salt, or saline solution, than when only the hygrometric moisture of the aëriform fluid is present. Mr. Laming also converts the hydrosulphate of ammonia contained in gas liquors into carbonate of ammonia by the following process:—A mixture of deutoxide of copper and charcoal, or other form of carbon in fine powder, in the proportion of twelve parts by weight of the former to one of the latter, is introduced into a retort made red hot and furnished with an eduction pipe which passes through cold water, and finally enters into the gas liquor. The formation of carbonic acid gas soon takes place by the union of the carbon with the oxygen of the metal, and this gas combining with the base of the hydrosulphate of ammonia converts it into carbonate, with liberation of sulphide of hydrogen. When the carbonic acid ceases to come away, nearly all the carbon will have disappeared from the retort, and the oxide of copper reduced to the metallic state. The charge is then drawn, and left to cool while a second charge of similar materials is being worked off; during which time the copper reabsorbs oxygen from the air, and becomes again deutoxide of copper, which may be used anew with fresh carbon.

Messrs. Crane and Tullien, in their patent of January 8, 1848, describe a method of manufacturing ammonia in the state of carbonate, hydrocyanate, or free ammonia by passing any of the oxygen compounds of nitrogen, together with any compound of hydrogen and carbon, or any mixture of hydrogen with a compound of carbon, through a tube or pipe containing any catalytic or contact substance. The substance which is preferred is platinum in the state of sponge, or asbestos coated with platinum. This is to be placed in a tube and heated to about 600° F., so as to reduce the temperature of the product, and at the same time prevent the deposition of carbonate of ammonia, which passes onwards to a vessel of the description well known and employed for the purpose of condensing carbonate of ammonia. The condenser for this purpose must be furnished with a safety pipe, to allow the escape of uncondensed matter, and made to dip into a solution of any substance capable of combining with hydrocyanic acid or ammonia.

Carbonate of ammonia is manufactured at the present time from a mixture of sulphate or chloride of ammonium and common chalk, heated in retorts and sublimed. The decomposition of the chloride of ammonium may be represented thus:—

$$3(H_4N,Cl)+3(CaO,CO_2)=3CaCl+2H_4NO,3CO_2+H_3N+HO.$$

In the manufacture of ammonia alum, the ammonia is derived from gas liquor; the liquor is heated, and nearly all the volatile ammonia driven off. The residue is taken out of the boilers and used for the manufacture of carbonate of ammonia. It is treated with a little acid till it is neutral, then evaporated by means of heat in large hemispherical iron pans set in brickwork. When it has arrived at the crystallising point, it is allowed to cool, and crystals are then deposited; or the hot liquor may be run into other coolers for crystallisation. The mother liquor is syphoned off, and then the inside of the pan is seen studded with intense black crystals, of the prismatic form when sulphuric acid has been used for the neutralisation, and cubical with hydrochloric acid. The crystals are now shovelled out of the pan, and washed with the mother liquor. They are then re-dissolved, the liquor run into coolers, and re-crystallised. In the re-dissolving a great deal of sediment is deposited, consisting chiefly of the matter mechanically locked up in the crystals. The crystals when dry are of a dirty white colour; they are now ready for the next operation of converting them into carbonate of ammonia. For this purpose cast-iron retorts, the shape of an elongated muffle, are used. The neck of the retort is round, and closed with an iron door, kept in its place by means of a screw. The retorts are about seven feet long and one and a-half deep. Three are set in brickwork in the form of a triangle, and heated by one fire. They communicate by means of iron pipes with a leaden chamber which is technically called a balloon. It is about six feet high, eight long, and two and a-half wide. These balloons are supported upon scaffolding so as to be on a line with the retorts, and are kept in their places by means of iron bands. At the bottom of each balloon is a small pipe, which is always kept open to allow for the escape of steam, and water highly charged with carbonate of ammonia. There is a constant dropping from this pipe, which is collected in a pail, and re-sublimed. If this pipe were not there, the pressure inside the balloon might cause it to be blown off the scaffolding. Great attention has to be paid to the heating of the retorts. If they were heated too strongly, most disastrous results might occur.

The retorts are charged once every twenty-four hours with a mixture of carbonate of lime and ammoniacal salt; the chalk is well dried on an iron plate which is set over the flue, so that the waste heat of the fires economically dessicates it. All the retorts are not charged at the same time, for often there are five and six sets; if they were, the labour would be too great, and a greater number of men would be required; but to do away with that difficulty one retort in each set is charged at the same hour every day; the first charging takes place at seven, the second at eleven, and the third at three, and by that time the whole of the retorts have been charged. The contents are frequently stirred up with long iron rods (which are pushed through holes made in the door of the retorts) to assist the decomposition. Before a new charge is put in, the pipes leading to the balloons are well cleaned out, as they are very liable to become stopped up. The used-up charge, which consists principally of chloride of calcium, is drawn out into an iron barrow and wheeled away to some waste ground; the new charge (which is generally two of chalk to one of the salt) and which has been carefully weighed and well mixed, is thrown quickly into the retort, the door is luted on, and then the retort is left for twenty-four hours, the contents receiving an occasional stir.

When the retorts have been worked for about fourteen days, the balloons are opened, and the impure carbonate is found as a thick crust lining all the sides; it is deposited in different coloured layers, according to the impurity of the carbonate. The chief impurities will be carbonate of lime and chloride of calcium, which are carried over mechanically; the salt is well scraped down from the sides, and the balloon prepared for another fourteen days' operation. These balloons have to be of considerable size, or there would be much waste from the salt being carried off by the steam; in each balloon is a small test-hole, closed with a plug of wood, this is for telling how the sublimation is going on. The impure carbonate is all collected and taken to the resublimation pans. The salt is put into iron tanks about sixteen feet long and two and a-half deep; they are wider at the bottom than at the top, being two feet seven inches at bottom and two feet at top. These tanks are closed with two plates of iron with four holes in each, about one foot in diameter and one foot apart from each other. Over every hole is placed a conical leaden vessel with a flat top. These vessels are formed of a sheet of lead, and the two ends are kept together by means of staples and wedges; a circular piece of lead is luted on the top of these receivers; the height of them is about two feet. The tanks are set in brickwork, with a fireplace at each end. They are charged every fortnight; a certain quantity of water is first put in, then the impure carbonate. The receivers are all luted on over their respective holes, and a small fire made at each end of the tank. Great care is required in regulating the temperature, because the heat must not be too high, as the salt sublimes from 120° to 130° Fahrenheit. In the end receiver is a small hole closed by a plug; on taking this out it can be seen whether the temperature is too high; if it is, the fires have to be damped. A thermometer is generally used, but some people prefer to trust to their own judgment. Instead of the tank and fires separate pots may be used, each one being surmounted by a leaden cap; these pots are either set in brickwork and heated by the flue of the retort furnace, or they may be set in a water bath. At the end of fourteen days the leaden receivers are lined with a thick crust of carbonate; they are taken down, and the lead stripped off; the outside of the block is rather dirty, it is well scraped, and then broken into pieces, packed in jars, and sent to the market. The leaden receivers are well washed and reshaped. A small quantity of the residuary liquor is taken out of the tanks, but the chief part is left in, a fresh charge of carbonate is added, the receivers are luted on, and the operation goes on the same as before.

The greatest use which is made of this salt is by bakers and confectioners; it is largely employed in medicine and in the manufacture of smelling salts.

Royal Institution of Great Britain.—The following are the lectures for the ensuing week:—Tuesday, Jan. 2, Thursday, Jan. 4, and Saturday, Jan. 6, 3 o'clock, Professor Tyndall, "On Sound" (juvenile lectures).

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, December 21.

Professor W. A. Miller, *M.D., F.R.S., President, in the Chair.*

The minutes of the previous meeting were read and the several donations to the Society's library were acknowledged in the usual manner. Mr. William J. Barnes was formally admitted a Fellow, and the following gentlemen were duly elected by ballot—viz., John Percy, M.D., F.R.S., lecturer on metallurgy, Royal School of Mines; Mr. Ernest T. Chapman, 25, Somerset Street, London; Mr. Charles N. Ellis, Bow Common; and Mr. Thomas Ward, Mechanics' Institution, Bolton. The names of the candidates read for the first time were,—Mr. Edward Purser, jun., 116, Fenchurch Street; Mr. William Thorpe, 13, York Terrace, Kingsland Road; Mr. Arthur E. Davies, Surgeons' Hall, Edinburgh; and Mr. Franklin Epps, Great Russell Street; and for the second time the names of the following,—Mr. Thomas B. Redwood, 19, Montague Street, Russell Square; Mr. John Conroy, Christ Church, Oxford; Mr. James Speir, Newcastle-on-Tyne; and Mr. Robert Henry Smith, Rodney Street, Pentonville.

The President said he was glad to notice among the visitors the presence of several gentlemen who had given attention to the subject of Mr. Yates' paper; letters of invitation had likewise been addressed to the Astronomer Royal and other eminent authorities, who were, however, unable to attend.

A communication entitled, "*On the Best Material for Mural Standards of Length,*" was read by Mr. James Yates, M.A., F.R.S. The author referred to a previous essay on this subject which he presented to the British Association for the Advancement of Science, and had the honour of reading at the Birmingham meeting in September last. His communication was followed by others stating the advantages of the metric system, and gave rise to an animated discussion, in which Dr. Williamson and other eminent chemists took part; and the result was that the Association appointed a committee for the purpose of promoting the extensive use of the metric system in scientific documents, the teaching of the system in schools and colleges, and for the general information of the people. The author's previous remarks on mural standards were arranged under the following heads:—The material; the form and dimensions; the description by means of letters, figures, and other marks; the distribution and exposure to public view; the use in education; the aids to be afforded by the British Association. To the first of these heads—viz., the material—the author proposed on the present occasion to limit himself, and he wished now to have the opinion of the Fellows of the Chemical Society upon this point. He had already offered (at Birmingham) a suggestion that Baily's metal be employed, but since that time doubts had been expressed in regard to the permanence of this metal under the usual conditions of atmospheric exposure. Baily's alloy consisted of copper sixteen parts, tin two and a-half, and zinc one part, and the use of it had been recommended in the "Act for Legalising and Preserving the Restored Standards of Weights and Measures," 18th and 19th Victoria, cap. 72, and actually adopted by the Royal Commissioners in 1843 under the supposition that it could not rust or form a loosely adherent oxide. An adverse opinion having lately been expressed, the author proceeded to criticise the respective advantages of a variety of other metals, alloys, and compound bars, which seemed to be capable of employment for these purposes, and advocated—if no scientific reasons should appear to the contrary—the use of ordinary brass covered with a thin coating of gold. The metals should be drawn out together, for the twofold purpose of hardening the gold and securing its perfect adhesion to the brass, and fine lines or divisions could then be engraved upon the face of the bar in such a manner as to remove the film of gold in those parts. By the action of the air upon the exposed portions of brass, distinctly marked lines would soon be formed of a black or greenish-bronze colour upon the bright gold ground. A bar, very attractive and ornamental in its character, would thus be produced, and one which the author considered to be admirably adapted for use as a mural standard, and by placing the yard and metre in apposition, would be likely to find favour and inform the minds of the British public. Several of these could be prepared and set up on the outside walls of public buildings both in the metropolis and in the provinces, if the cost of from three to four pounds each would not be judged excessive. Mr. Yates then referred to the possibility of reducing the cost by the substitution of a coating of platinum, or of an alloy of platinum and iridium, for the gold; and proceeded to enumerate other suggestions relative to the employment of the best kind of aluminium bronze (60 parts copper and 40 of aluminium); speculum metal, improved by the addition of a little arsenic; and lastly, for in-door applications, of steel, which had the sanction of the Rev. R. Sheepshanks, although it was well known to be liable to rust. The author stated that he noticed rust upon the steel standard last referred to, even whilst it was on view at the Paris Exhibition of 1855, and he believed its condition could now be ascertained by a visit to the *Conservatoire des Arts et des Metiers.* The author concluded by referring to mural standards already open to public inspection on the outside walls of the Royal Observatory, at Greenwich, and of Messrs. De la Rue's manufactory, in Bunhill Row; by exhibiting some accurate metre scales prepared by Mr. James Gargory, 41, Bull Street, Birmingham, and by Messrs. Elliott Brothers, of the Strand, London, besides lithographic representations of the same; and invited discussion upon the several points raised in his paper, promising for himself and colleagues to submit a statement embodying the chemists' decision to the ruling authorities of the British Association.

The long and interesting discussion which followed the reading of Mr. Yates's paper will be reported next week. Before adjourning the meeting, the President moved a vote of thanks to the author, and announced that on the next occasion, January 18th, Dr. J. H. Gladstone would read a paper, "*On Pyrophosphotriamic Acid,*" and that on 1st February Dr. Gilbert would address the Society upon an agricultural subject.

PHARMACEUTICAL MEETING.

Wednesday Evening, December 6.

(*Continued from page 299.*)

Dr. Attfield read a paper entitled "*Observations and Experiments on the Physics of Filtration.*" Dr. Attfield's paper was of great length, and our space allows us to give but a very short abstract. He began by thus defining the nature of filtration:—"The nature of the operation of filtration, as usually conducted, is so simple that but little has been or need be published concerning it. The variety of circumstances under which filtration is conducted, as well in social as in commercial life, has given rise to many contrivances for effecting the operation; filtering materials are numerous, the forms of the vessels designed to hold the materials scarcely less numerous, and the arrangements to facilitate and perpetuate filtration many and ingenious; but the nature of the operation, as distinguished from the operation itself, is the same, or nearly so, under all ordinary circumstances. Indeed, its nature is identical with that of some operations which, conventionally, are quite distinct from filtration, and which are always spoken of by other names. In the process termed sifting we have the same action occurring as in filtration; it might, in fact, be called 'dry filtration.'* In the netting of fish we also have the same action. Again, the operation of 'straining' even still more closely resembles that of filtration. The nature, then, of the operations conducted with filters, strainers, sieves, or nets is identical; the operations themselves quite distinct, and, very properly, called by different names. What I wish to speak of now is not the operations themselves, but their nature—that is, the laws which regulate their action, especially in respect to filters." After noticing the resistance offered by various filtering media, he dwelt at some length on the different aids to filtration—viz., (*a*) *hand pressure*, (*b*) *lever or screw pressure*, (*c*) *hydraulic pressure*, (*d*) *atmospheric pressure*, (*e*) *hydrodynamic force*, or to *a combination of these forms of pressure*. Under the fifth head, filtration aided by hydrodynamic force, the author described the filter invented by Mr. Schacht, in which the pressure is produced by the influence of a column of water below the filtering medium. With this instrument Dr. Attfield has made numerous experiments, the results of which are of no immediate practical interest. We append the author's summary, which will give our readers an idea of the scope and results of Dr. Attfield's experiments:—"The practical applications of the truths we have been considering are for the most part obvious, and already well known to all. But of what new value are they? as follows:—Firstly, these observations and experiments give us, I think, clearer, more correct views of the nature of the operation of filtration than most of us had before. We should, I think, regard filtration under any and all circumstances from a hydrodynamic point of view. We should regard it as the flow of a liquid from an orifice in the vessel containing the liquid, the flow being interfered with or resisted to a greater or less degree by a porous fabric, termed a filtering medium. The rate of flow we should regard as normally following that described in the theorem of Torricelli—namely, in proportion to the square root of the distance from the orifice of outflow to the surface of the filtering liquid; or, as the law may perhaps be stated for our purpose, 'the rate of flow is proportionate to the square root of the power,' whether that power be derived from gravitation, muscular or mechanical force, or the elasticity of compressed air or steam. As the flow becomes slower and slower, the manifestation of this dynamic law becomes less and less evident, and the existence of a static law in the instrument more and more evident, until, when the flow ceases altogether, a static pressure only exists within the apparatus; hydrostatic in the common conical and other simple filters, the filter bag pressed in the various ways, and the filter in which there is a column of liquid above the medium; aërostatic where the air is removed from below a medium or additional air, &c., forced on the filtering mixture from above, or where there is a column of liquid maintained below the medium. As a filtering medium always presents some resistance, dynamic laws can never apparently exclusively obtain in a filtering apparatus, though they nearly do so in the filtration of water for drinking purposes. So also, as that resistance can never be complete, filtration can never be a static operation, nor can static law exclusively obtain in a filtering apparatus, until the latter ceases to be a filter, though they nearly do so when the filtered liquid is escaping drop by drop, as may generally be seen in an analyst's filter. Though, however, a filtering apparatus can never be the exclusive seat of either dynamic or of static laws, it is quite possible that *the flow* from the apparatus is governed purely by dynamic laws. The rate of flow does not *appear* to be a pure dynamic rate. probably because we can only compare it with the total amount of force applied. But a portion of that force is expanded in producing static pressure within the instrument; the residue, if we could estimate it, would probably show that the flow from the filter is actually, though not apparently, a flow proportionate to the square root of the amount of force which produces it. For instance, a filter is giving a certain number of drops per minute, under a certain amount of force; double the amount of force, and we get nearly double the number of drops: in the first case, nearly all the force is expended in producing static pressure within the instrument, the residue being expended in producing the flow; in the second case, also, nearly all the force is expended in producing static pressure within the instrument, but not quite twice as much as in the first case: thus, probably, the residue of power is four times greater than in the first case, and hence we get a double flow. And so on, until, with a free orifice, there is no static pressure at all within the instrument, when we get a rate of flow which is apparently as well as actually dynamic. It is for these considerations chiefly that I think we should regard filtration in a dynamic aspect. A less strong, though more obvious reason, is that useful filtration—that is, rapidity of flow—is in proportion to the extent to which dynamic laws obtain in filters. Secondly, we have been told that pressure filters have not hitherto proved of the service in Pharmacy that was expected of them; that where they are most needed—namely, for the separation of solid matter in a very minute state of division or in a flocculent condition, there they fail, and that a turbid instead of a clear and bright filtered liquid results. Now, so long as we consider pressure-filters to be static instruments, this result must be inexplicable. But once realise their dynamic character, and the explanation of the fact would seem to be this,—a flock or particle of solid matter finds itself at the mouth of a pore of a filter; if that particle were the object of static laws only (aërostatic or hydrostatic), there it would remain, resting, so to speak, on the edges of the pore, and there it would remain, we will suppose, if the pore were the pore of a common filter in a common funnel, the pressure that is above the particle being in this case only slightly greater than that below the particle; but now greatly increase the pressure on that particle from above, either directly by adding pressure, or indirectly by taking pressure from below, then the particle is at once shot through the pore, it being compressed if it be a flock, or it itself enlarging the fibrous interior of the pore, if the particle being incompressible, and if the pore be in paper, cotton, wool, &c. In other words, the force which increases the gravitating motion of fluid particles through the pores of a filtering medium; increases the gravitating tendency of any solid particles which may be resting within or on the edges of those pores. This explanation (and the being able to give explanations of facts is a matter of practical value) follows, I think, from the consideration of our subject. In Mr. Schacht's pressure-filter, this stated objection to the old pressure-filters may possibly not obtain, because the pressure can be increased so gradually that the consolidation of the particles of solid matter, which are constantly increasing the resistance of the filtering medium, goes on *pari passu* with the pressure itself; in other words, the closeness of the filtering medium in his instrument increases regularly with the pressure instead of spasmodically, as in other older instruments. Whether this be so or not, can only be determined by experience in the use of his filter. Thirdly, apply hand pressure, lever, or screw pressure, and hydraulic pressure, directly to as small a portion of the surface of a filter-bag as possible. Fourthly, if, in filtration, pharmaceutists, engineers, and others desire to have the full benefit which the use of a long column of liquid below their filter gives them, that column must be perfectly continuous,—there must be no break in it caused by the introduction of air from without the instrument, or by the accumulation of air coming out of solution in the water, as we all know it will do when atmospheric pressure is removed. The practical means of getting rid of such accumulations I have already described

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* Similarly, "filtration" might be called "wet sifting."

—namely, in the introduction of a small glass reservoir between the upper surface of the filtering medium and the surface of the water in the vessel in which the medium is placed. A small stopcock in the top of such reservoir would allow of the expulsion of any accumulated air on merely closing the orifices of outflow. For example, the carbon block and casing of the 'cistern-filter' of Messrs. Atkins might have such a reservoir placed above the centre of the block, communicating with a glass tube and cork with the central cavity of the block. Fifthly, since writing this paper, and only a few hours before its delivery, Mr. Schacht has told me that his original idea in devising the form of filter he described at Birmingham, was simply the production of an aërostatic instrument, the hole in the upper part of the chamber beneath the filtering medium being placed there to admit of the long tube being conveniently filled, and not to ensure the removal of every trace of air from that chamber. On examining the filter he brought to me, I at once saw that all the air was not removed, that sufficient remained to interfere with, though not to destroy, the continuity of the column. I would, therefore, more distinctly than in the last paragraph, propose an improvement in his filter. I would suggest the blocking up of the small side-hole in his instrument altogether, and the adoption of a narrow channel of communication from below to above the medium, terminating in a glass flask and stopcock as already described. The plane of the perforated metal plate on which the medium rests, might be slightly inclined, and the small channel be then at the side rather than in the centre of the medium."

The discussion on the paper was postponed until the next meeting, but Mr. Schacht explained the principle of his filter, and Dr. Redwood addressed a few observations to the meeting, in the course of which we understood him to say that Dr. Attfield's observations and experiments had nothing to do with filtration, properly so called, but were concerned with the rate of flow under different conditions and circumstances.

BRISTOL NATURALISTS' SOCIETY.

December 7.

A PAPER was read by Mr. HENRY BRIGHTMAN "*On the Application of the Photographic Printing Process for Producing Copies of Botanical and other Specimens.*" To lay plants, &c., upon prepared paper, and expose them to sunlight, was a method which had been frequently practised, but the pictures so obtained were, technically, negatives, the representation of the object being white, on a dark ground. It occurred to the author that if these could be rendered transparent positives might be printed from them. He found, however, that this could be readily done without any previous preparation of the negative, and he exhibited a number of very beautiful photographs produced in this way of ferns, leaves, and even a butterfly's wing, showing the wide applicability of the process. Mr. Brightman then described the process in detail; for the negatives the albumenised paper should be as thin and free from grain as possible, and sensitised by floating on a 60-grain solution of nitrate of silver. An ordinary printing frame was used, but a very long exposure was requisite, especially for positives, and this constituted the chief objection to the process, where many copies were required, as for illustrating a book. The toning bath contained half an ounce of acetate of soda to one pint of water, and one grain of chloride of gold for each sheet toned. The picture was fixed with hyposulphite of soda (eight ounces to the pint), and well washed with water.

Much conversation then took place on this paper, in the course of which Mr. Beattie urged the employment of waxed paper, instead of albumenised, as likely to give a more transparent negative, and spoke of the application of carbon printing to this process. Mr. Brightman suggested the use of a green instead of a black pigment in that method, to give the natural colour of the plant. Mr. Ravis mentioned the expense of the silver process as an obstacle to its employment on a large scale. The possibility of printing negatives on dry collodion or tannin plates was suggested.

December 13.

Mr. W. L. CARPENTER read a paper on "*Pharoah's Serpents' Eggs*," the chemical toy now so common, and gave the results of experiments that he had made to ascertain the composition of the serpent. As was well known, the white powder forming the egg was sulphocyanide of mercury, and the author described several modes of preparing it. Theoretically represented by the formula $HgCyS_2$, it would contain 63·3 per cent. of mercury, and the specimen he analysed yielded 64·9 per cent. The loss of weight on burning was 19·27 per cent., and as the product contained 70·5 per cent. of mercury, it followed that about one-seventh of the mercury in the egg was volatilised. He showed an experiment to prove that the serpent form was not, as was generally supposed, caused by the cone of tinfoil, and described others which led him to believe that the blackness of the inside of the serpent was due to the mechanical mixture of sulphide of mercury with mellon, or melam, products of the decomposition of the sulphocyanides which had been studied by Liebig. The brown exterior contained no sulphide of mercury, and, when treated with nitro-hydrochloric acid, yielded a solution in which sulphuretted hydrogen caused a yellow flocculent precipitate, the nature of which he had not ascertained. The specific gravity of the serpent was 0·069, water being 1·000, and such was the continuity of the skin that no air escaped through it when the serpent was sunk in water.

Mr. CARPENTER then exhibited a photograph, sent by Mr. P. J. Worsley, showing what facilities the paper process gave for getting quantity, and also the desirable quality of size, as well as the advantages over working with glass plates as regarded portable apparatus. A friend of Mr. Worsley's had taken out, on a trip, seventy sheets ready prepared by the turpentine waxed paper process, and had had no failure among them, although the exposures varied from five minutes to four hours.

Mr. NOBLE, the Secretary, exhibited a series of very beautiful paper negatives, taken by Mr. West, of the Clifton Observatory, of large size. The process was the ordinary iodized paper one, the sheets being waxed either before or after exposure, no preference being given to either. It was generally allowed by those present that where long exposure and slow development were possible, no process was equal to this for the exceeding beauty of detail obtainable by it.

CORRESPONDENCE.

The New Metric Standards.

To the Editor of the CHEMICAL NEWS.

SIR,—Referring to the proposal made by Mr. Yates at the Chemical Society's meeting of Thursday last, for the public exhibition of the yard and metre in juxtaposition as mural standards, I beg leave to suggest that the English yard be made of stout ruby glass (flashed), and the French metre of white glass, superficially coloured with cobalt blue.

The requisite lines and divisions, as well as the accompanying verbal descriptions, may then be produced by grinding away the coloured surfaces in a manner so frequently practised in ornamenting vases and other works of art. Such materials would be incorrodible, like porcelain, and present a more attractive appearance, would expand by heat much less than metals, and offer less temptation to the London thief than the platinum or gilt bronze which have been favourably spoken of for these purposes.

I am, &c. F.C.S.

December 27.

Estimation of Sulphur in Mineral Waters.

To the Editor of the Chemical News.

Sir,—Having lately been engaged in the examination of a mineral water in which I am somewhat interested, and which possesses the strange combination of sulphate of iron and hydrosulphuric acid, I met with considerable difficulty in employing the usual tests for the estimation of the H_2S. No estimation with silver could be attempted on account of the reducing agency of the $Fe''SO_4$ Dupasquier's method was rendered uncertain by the same cause, and the liquid, moreover, when even moderately heated, assumed the troublesome red tint which it is liable to do when heat is obliged to be employed and the solution to be tested is acid. Arsenic was inapplicable on account of the small proportion of sulphur present, when I bethought me of the following simple method:—Some sulphate of lead was prepared by precipitation from boiling solutions, and was well washed with boiling distilled water, and while still fresh and moist successive portions were added to the mineral water till the brownish-black colour of the precipitate first formed turned to a decided grey, showing that the H_2S had all been removed from the solution and that some undecomposed lead salt remained in excess. The supernatant liquid was decanted from the precipitate, which rapidly settled down, and the latter was rapidly washed on a filter with boiling distilled water, and subsequently with hot solution of acetate of ammonium, till the washings were no longer coloured by the addition of an alkaline sulphide or by H_2S. The filter was now carefully incinerated, and the $Pb''S$ was oxidised by an addition of a little HNO_3 and evaporated with a little HSO_4 until heavy fumes of the latter began to be evolved. Subsequent dilution with water gave a precipitate of $Pb''SO_4$, which was separated by decantation and weighed, and from this was calculated the amount of H_2S which had been present in the water.

I enclose a small book containing the analysis of this interesting source, by Professor Filhol, and which may perhaps interest you. I am, &c.

F. Maxwell Lyte.

Bagnères de Bigorre, December 16, 1865.

Cleaning American Clocks with Soda.

To the Editor of the Chemical News.

Sir,—Some of your readers were doubtless amused some time since by seeing a paragraph in the papers headed "How to Clean American Clocks." I did as directed,—boiled my clock for some hours in caustic soda, washed copiously, hung on the jack, and dried quickly. The clock was an eleven-shilling one, gone regularly for ten years, but lately taken to stopping through clogging up of the pinions; it has since behaved itself well, gone regularly, and keeps good time. The treatment is peculiarly applicable to these clocks, for, owing to their low price, our professional clock-cleaners do not care to meddle with them. I am, &c. Chemicus.

London.

MISCELLANEOUS.

Observations with the Water Barometer.—Mr. Bird, of Birmingham, sends us the following:—On Tuesday night last, December 12, the tidal column rose to 406 inches, being the highest I have ever observed, showing an extraordinary increase in the atmospheric pressure. On November 27 the water stood at 374 inches; it had, therefore, risen on Tuesday last to within 4 inches of 3 feet, showing that there was added to the atmospheric pressure a weight equal to a column of water nearly a yard high and equally spread over the whole country, the height of the water being actually visible to the eye in the water barometer. 406 inches is 33 feet, the highest that a pump would work, last Tuesday.

Dr. Hofmann's Reply to Dr. Phipson.—We have received an article just published by Dr. Hofmann under the title, "Aufklärung für junge Chemiker," in reply to Dr. Phipson's "Warning to Young Chemists," published in *Cosmos*. We regret that the pressure on our space prevents us from inserting a translation in this number; but it will appear in full in our next.

Metallic Titanium.—Within the past few months titanium metal is stated to have been obtained in considerable quantities in Birmingham, by reduction with sodium, the resulting powder being fused into compact masses of large size; the similarity of titanium and iron is striking. Little doubt is entertained that ere long the new metal will be produced at about the price of silver, in which case many practical applications could, probably, be found for it. The metal is largely disseminated in nature, so that once introduced a constant supply could be depended on.—*Mining Journal.*

Simple Method of Preventing Boiler Incrustations.—In a manufactory at Lorenzchacht they use water holding a little clay in suspension, and after three months' work find on the sides of the boiler only a little mud, which is easily scraped off. This mud is nothing more than the clay itself, which prevents the deposit of crust mechanically by keeping the particles of deposited matters apart.

Process for Rendering Wood Plastic.*—A very simple method of rendering wood plastic has recently been discovered. It consists in injecting diluted hydrochloric acid into the wood under a pressure of about two atmospheres. The duration of the operation must be regulated by the nature of the wood, the bark is not removed, and by a very simple arrangement the liquid injected at one extremity may be partially collected at the other. If the green wood is submitted to pressure, the cellules having been previously washed with water, it may reduced to a tenth of its original size; the fibres may be excessively compressed without breaking or tearing, and when dry have no tendency to resume their natural condition. Woods treated in this way will serve for many purposes. If after the treatment with hydrochloric acid the wood is washed and dried, it may be cut and chiselled with great facility, and serves admirably for sculptural purposes. The wood is dried by passing air under pressure through the cellules at about 37°, the moisture is rapidly expelled, and as the mass contracts evenly throughout, there are no cracks. Colours or the various substances which prevent wood from rotting may be injected in a similar manner; soluble glass or freshly precipitated silica renders it very durable and at the same time incombustible.

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine-Office Court, Fleet Street, London, E.C. *Private* letters for the Editor must be so marked.

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H. B.—Will receive a private letter.

Cal.—A solution of bicarbonate of lime reacts alkaline.

Dr. Letheby and *Mr. T. Gibb.*—Received. Shall be published next week.

Received.—Clerious; C. B. C.; Dr. S. Muspratt.

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* *Wochenschr. des Nied. R. Oest. Gew.-Vereins*, 1865, p. 502.

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